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THE RUBBER AGE

ESTABLISHED 1917

One of the World's Outstanding Rubber Journals

JULY
1939

VOLUME 45
NUMBER 4

INDEX TO CONTENTS

Properties of Rubber Revealed by Mechanical Tests—*By Felix L. Yerzley* 211

Exchange Agreement Provides Trade of Cotton for Rubber 215

Rubber Suspension—*By A. S. Krotz* 217

Airflex Rubber Clutch 222

White Sidewall Paint 222

Charles Goodyear (A Biography)—*By P. W. Barker*..... 223

Crystex Insoluble Sulfur 226

Tire X-Ray Device 226

Rubber at the N. Y. World's Fair: Firestone Exhibit 227

REGULAR DEPARTMENTS

New Equipment Section ..	230	Obituaries	242
Book Reviews	231	Los Angeles News	240
Editorials	232	Rubber, Cotton Markets ..	243
Late Domestic News	233	Chemical Markets	244
Financial News	236	Statistics	245
Names in the News	239	Market Place	249
Coming Events	235	Classified Ads	254

Published on the 15th of each month by

PALMERTON PUBLISHING COMPANY, INC.

Printing office,
East Stroudsburg, Pa.

Editorial and Advertising Offices,
250 West 57th St., New York City

Entered as Second Class Matter, October 20, 1933 at the Post Office at East Stroudsburg, Pa., under Act of March 3, 1879. Subscription Rates: Domestic, $2.00 a year; Canada, $2.50; Foreign, $3.00. Single copies up to 3 months old, 25 cents; over 3 months old, 50 cents. Telephone COlumbus 5-2923, 5-2924. Contents Copyrighted 1939 by the Palmerton Publishing Company, Inc. Indexed in Industrial Arts Index. OFFICERS: P. L. Palmerton, President; E. D. Osborn, Vice-President and Secretary; Peter P. Pinto, Treasurer.

Also Publishers of:

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Next Issue—July, 1939

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The Rubber Age

Published Monthly at East Stroudsburg, Pa.
Editorial and Advertising Offices: 250 W. 57th St., New York

Vol. 45 July, 1939 No. 4

Properties of Rubber Revealed by Mechanical Tests

By Felix L. Yerzley

Physicist, Rubber Chemicals Division,
E. I. du Pont de Nemours & Company, Inc.

THE mechanical tests of rubber and rubber-like materials depend upon the deformation of test specimens under an applied load. They may be run to determine the fundamental relationships between force, deformation, and time under a variety of conditions, or they may be run for comparative purposes only under conditions too complicated to yield fundamental information. Tests of the former type yield properties of materials while tests of the latter type supply data on over-all performance of some particular shape of test specimen under unique conditions.

As the science of rubber testing advances, it will become increasingly possible to predict performance under complicated conditions from measurements of its fundamental properties. The degree of faith we can have in such predictions will indicate how far we have traveled along the road from the empirical art of rubber technology to the more general advantages of a science.

This paper is intended primarily to stimulate thought on the significance of some of the common mechanical tests of rubber. To do so it is necessary to define clearly the meaning of terms frequently used quite loosely in rubber technology. In the following paragraphs an attempt is made to clarify the meaning of the word elasticity and related terms. The definitions will apply to familiar load-deformation relationships regardless of the type of loading in shear, compression, or tension.

This paper was presented at the 42nd Annual Meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June 26-30, 1939.

Elasticity

The application of force to any physical body changes either its shape or volume, or both. In the case of rubber or rubber-like synthetic materials, it is known that in most practical cases the change of volume as the result of an applied force is negligible. The change of shape under the influence of applied forces, however, is unique in its magnitude. Few substances can be deformed without rupture to the same extent as rubber or its physical brothers; none can be deformed to such a high degree and regain original dimensions so completely. The characteristic recovery of rubber-like materials causes them to be called *elastic*.

A material is perfectly elastic when its load-deformation characteristics are repeated point for point as the load is removed. In terms of graphic representation, the load-deformation curve must be retraced exactly and completely as the load is removed.

The statement applies only if the test is made under adiabatic conditions, since modification of the load-deformation curve would result from gain or loss of heat during the loading-unloading cycle.

Energy

When a constant force F acts through a distance S, the energy expended is their product, $F \times S$. If the force is not constant but varies with distance the general expression for mechanical work is used:

$$\text{Energy} = \int_{S_1}^{S_2} F dS$$

In either case the energy is expressed in terms of force times a distance, for example, in inch-pounds or dyne-centimeters (erg). Energy is found from a load-deformation curve by measuring the area under the curve and multiplying it by the factor derived from the scale used on the coordinate axes. In this way the area is converted to its equivalent energy in work units. When a test includes both loading and unloading of a test specimen, the area under the loading curve represents the work expended on the test specimen by the machine; the area under the unloading curve represents the energy returned to the machine by the test specimen.

Hysteresis

Most materials do not trace the same curve on loading and unloading. The discrepancy results from failure of the material to recover its dimensions instantaneously. The failure to recover may be temporary or permanent, or a combination of temporary and permanent deformation. Mathematically:

$$\text{Hysteresis loss} = \text{Energy expended in loading} - \text{Energy returned in unloading}$$

$$\text{Percentage hysteresis loss} = \frac{\text{Hysteresis loss} \times 100}{\text{Energy expended in loading}}$$

The hysteresis loss of a perfectly elastic substance is zero.

Resilience

The energy returned to a test machine by the test specimen on unloading is the resilience of the test specimen. Resilience is commonly expressed as a percentage of the energy expended during loading. Percentage resilience is thus synonymous with efficiency:

$$\text{Percentage resilience} = \frac{\text{Energy returned in unloading} \times 100}{\text{Energy expended in loading}}$$

The resilience of a perfectly elastic substance is 100 per cent.

It is evident from the foregoing that under adiabatic conditions for any given cycle of loading and unloading:

$$\text{Percentage hysteresis} + \text{Percentage resilience} = 100.$$

Methods of Testing

In most applications of rubber, the individual physical and chemical factors contributing to the overall performance are so numerous and inseparable that the industry has acquired a preference for tests which duplicate some particular type of service as closely as possible. These tests are so involved that a pertinent discussion of fundamental properties appears to be quite impossible. Among these might be included abrasion tests and tests for resistance to flex cracking. There are other tests, more closely related to fundamental conceptions, which are the primary concern of this paper. Each of these gives at least qualitative information regarding some fundamental property. Some give quantitative information, but the test conditions are not necessarily the best possible selections. To illustrate this statement, a few tests will be briefly examined. No attempt is made to cover the field, but a few representative tests have been selected either because they are commercially important or because they are of timely technical interest.

Tension Testing (A.S.T.M. Tentative Method D 412-36 T).[1]—Intended as a comparative test between stocks and as a criterion of cure under standardized conditions, tension testing is perhaps the most important control test in the industry. However, the test is subject to misinterpretation and has probably caused considerable misunderstanding between rubber technologists and technicians in other fields.

There are two important reasons why stress-strain data obtained by the standard test are primarily of value only to rubber technologists. The first is that the data are obtained over an extreme range of deformation not ordinarily encountered in service. Except for a very small class of articles, rubber is used less for its ability to stretch more than 500 per cent than for its ability to stretch up to 50 per cent. Usually flexibility and high resilience are the primary requirements, and ability to survive extreme deformations of secondary importance. The second factor limiting the general usefulness of the standard stress-strain test in tension is that changes occur in the stress-strain curve as the result of repeated cycles of loading and unloading. For the sake of laboratory economy it may be necessary to standardize on the first loading of test specimens for the determination of moduli, but the values obtained in this way may be quite remote from values after several cycles of loading and unloading. We are familiar with the necessity of running rebound tests four or five times before the data obtained are constant from trial to trial. The changes caused by stretching rubber several times before taking final tensile data are no less real. Therefore, the properties that are measured, though characteristic, are but temporary and of limited usefulness with reference to practical conditions.

The prescribed rate of pull is 20 in. per min. for the power-driven clamp in the testing machine. Inasmuch as data are recorded not for the elongation of the test specimen as a whole but for the elongation of the rubber between bench marks on a constricted portion of the test specimen, the definite specification of machine speed does not mean that the actual speed of elongation of the test specimen has been standardized. (The rate of elongation can be more closely controlled by following the European practice of using ring test pieces, but the stresses are more complicated.) To correct this difficulty, machines might be designed to run at such a speed that the bench marks would be separated at a definite rate. For properly vulcanized materials, the rate of pull is not as important as it is for under-vulcanized or partially plastic materials for which appreciable deformation under load with the progress of time is characteristic.

Compression Set (A.S.T.M. Tentative Methods of Test D 395-37 T).[2]—In the A.S.T.M. compression set test, a disk ½ in. high and 1.129 in. in diameter is spring loaded at room temperature under 400 psi. The test specimen and spring assembly are then placed in an oven for 22 hr. at 70 C. At the end of 22 hr., the test specimen is removed from the spring assembly as quickly as possible and is allowed to cool and recover for 30 min. at room temperature. At the end of

this recovery period its net change in height is recorded as a percentage of the original height.

The intent of this test is to measure departures from perfect elasticity by a combination of two severe conditions: (*a*) overloading and (*b*) elevated temperature. Two factors which are unknown quantities in the application of this test are (1) the change of modulus resulting from temperature change and (2) the amount of plastic flow introduced by heating. Usually the end surfaces of the test specimen after removal from the loading device are decidedly concave, and the significance of the result is further masked by this irregularity.

It is apparent that the measurement of compression set by the A.S.T.M. method evaluates no single property of rubber and is not subject to clear interpretation. The load conditions may roughly approximate those occurring in a limited number of gasket or mounting applications, but the end measurement is not obviously related even to the satisfactory performance of these. The test may be quite useful in the writing of specifications for a given composition which has been found by suitable tests to be satisfactory. However, it is unwise practice to reverse the procedure and select a composition on the basis of the test except for special service conditions approximating those of the test. In particular, this test cannot be substituted for long-time tests of drift or creep of compositions intended for supports in vibrating structures.

Rebound Tests for Resilience.—Many arrangements of rebound apparatus are used to measure the percentage resilience of compositions. In these a weight is released from an elevated position and falls under the action of gravity to strike a test specimen. After impact, the weight rebounds to recover part of its original elevation. The height recovered by the weight on rebound when divided by its original height above the test specimen gives a fraction for resilience which may be expressed in per cent. Hysteresis may, therefore, be obtained by subtracting the percentage resilience from 100. The figure obtained in this way will include the frictional losses of the machine and any loss at the interface between the test specimen and the impacting surface.

A particularly successful form of the apparatus appears to be the pendulum type which is represented, for example, by Schob's machine manufactured by Schopper[3] in Germany. A 250-g. hammer swinging on a 20 cm. radius falls through an arc to strike a slab mounted on the vertical surface of the base of the machine. The energy of the impact can readily be calculated. The distribution of the energy in the test specimen, however, cannot be determined since neither the volume of the rubber distorted by the impact is measured nor is the distribution of stresses in the sample known. The loading conditions are irregular because of the spherical shape of the hammer. At the instant of maximum penetration of the hammer into the rubber, the stress is maximum at the center of the hammer and gradually decreases to zero at points sufficiently removed from the center. The value of the stresses also varies from sample to sample depending upon the hardness of the compositions even though the same impact energy is used for each test. The influence of this inherent variation in the loading conditions of the test can be investigated qualitatively for any given sample by determining the relationship between the rebound values and the elevation from which the hammer is released. Quantitative interpretation in terms of the elastic characteristics of the sample is not practical. The test is useful for a comparison of similar compositions of about the same hardness, since the load conditions will then be similar. Comparison of stocks of widely different hardnesses may be misleading.

In the Schopper test the rebound is rapid, so the hammer is in contact with the test specimen for a very short time, perhaps for as little as a thousandth of a second. This is significant, for compounds which appear quite resilient in a rapid test sometimes show much lower resilience in a slower test. Complete reversals in the order of resilience have been observed in tests on the Schopper pendulum and the oscillograph discussed below.

Oscillograph.[4]—The original purpose of the machine was to evaluate the properties of compounds used for rubber supports. A compressive load is applied either statically or dynamically to a pellet ¾ in. in diameter and ½ in. high and the relationships between the load, compression and time can be measured. Static loading and unloading may be determined by recording percentage compression resulting from application of known loads expressed in pounds per square inch. The energies involved in loading and unloading may also be determined under these essentially static conditions and, finally, the gradual compression of a test specimen under a given fixed load with time. The data obtained in this way are applicable to the preliminary design of rubber mountings. It is not sufficient, however, to know what the characteristics are under static conditions since the primary justification for rubber mountings is their suitability to the isolation of shock and vibration which are dynamic in character. For design with reference to dynamic applications it is also necessary, therefore, to know the dynamic properties of the material including the modulus and damping action. These are derived from an oscillogram, which is an autographic record of oscillations imparted to a lever of known moment of inertia subsequent to absorption of a known impact by a test specimen of the vulcanizate under test. The particular value of the oscillograph is that it yields data under definitely recognizable conditions which can be mathematically related to actual application of rubber cushioning devices, and in addition it has value as a general laboratory test, particularly for record purposes.

Goodrich Flexometer.[5]—A test cylinder 1 in. high is subjected to a known average compressive load by means of a lever arrangement. The upper platen of the machine is caused to vibrate vertically through a definite stroke at a known frequency.[6] The load, the stroke, and the frequency can be adjusted for any test, but having once been established for a test, they are maintained at the same value until the end point is reached. Mechanical working of the compound in this manner would cause no increase of the temperature of the test specimen if its resilience were 100 per cent. Since no compound meets this ideal, all tests result in a rise in temperature of the test specimen. A thermocouple laid between a hard rubber disk on the lower platen of the machine and the end of the test specimen is used to follow the temperature rise at an arbitrary point.

It is essential to the proper performance of the flexometer that the lever be free from the vibration impressed upon the test specimen. Practically, this is accomplished by suspending equally heavy weights at each end of the lever. These increase the inertia of the lever system without affecting the load on the test specimen. By increasing the inertia of the lever, its natural period of vibration is given a length of

several seconds. At a nominal speed of 1800 r.p.m. (actual speed about 1720 r.p.m.), there are 30 complete cycles per second. Since this frequency is high in comparison with the natural frequency of the lever, the lever remains undisturbed by the vibration of the test specimen.

In comparison with the service of a tire, the following points are pertinent: if the radius of a tire from hub center to the road is 15 in., 670 load cycles (loading and unloading) per minute would correspond to a road speed of 60 m.p.h. The test is accelerated, therefore, in regard to frequency. However, since the angle of contact between the tire and the road at any instant is a small fraction of the 360 deg. around the hub, most of the actual loading and unloading at any point occurs more rapidly than it does in the test.

The range between maximum and minimum load on any portion of tire tread during each revolution is from maximum pressure of the tire on the road to zero when the tire is not in contact with the road. The maximum is determined by the weight on the wheel, the inflation of the tire, the characteristics of the tread compound, tire design, and other complicated factors not measurable or subject to duplication in a test. In the test, the specimen is subjected to an average load, as is the tread in service, but the specimen is under compression at all times, whereas the load on a tread is zero most of the time. Since the maximum instantaneous load borne by a tire tread is determined in part by the mechanical characteristics of the compound, it seems reasonable to allow the maximum load to be obtained in the same way in the test.

With respect to mathematical analysis, the temperature rise of a compound vibrating under a load is an indication but not an accurate measure of hysteresis loss. Exact evaluation of hysteresis loss by thermal means would require a knowledge of (*a*) the thermal capacitance of the test materials, (*b*) the thermal conductivity of the materials, (*c*) the distribution of heat losses from the surfaces of the test specimen by radiation, conduction and convection, and (*d*) the mathematical relationship for heat flow through a test specimen whose configuration and instantaneous temperatures are changing at the frequency of vibration. A solution of the problem does not seem likely, even assuming that painstaking research on one compound or one series of compounds might lead to a basis for limited calculation.

For a given class of compounds, the test is significant as an indication of the tendency to develop heat under severe conditions. Its particular advantage over other tests for hysteresis is that the element of fatigue and operation at elevated temperatures resulting from energy absorption are brought into play. Since these factors are important in the operation of automobile tires and belting, the field of maximum usefulness would seem to be apparent. Yet with the increasing use of rubber springs, particularly where damping action is required, fatigue tests of this type should find increasing use for final confirmation of spring designs. It should also be apparent that tests may be made in shear in the same type of apparatus by using a shear type of test specimen patterned after simple types of commercial shear mountings.

Hardness.—By convenience attained by no other test and by long usage, hardness measurements have become firmly established. Rubber is virtually incompressible, although its elastic compliance to irregular surfaces is appreciable. Its compliance in this sense serves as the basis for the familiar indentation tests. In general, the recognized hardness tests, operating on a flat surface, employ a washer face held against the composition to define the area of the test. The penetrating pin is brought against the exposed surface of the composition through the hole in the washer. Two methods of running the test are common at the present time. In the first and more popular method pressure of the rubber against the pin is resisted by a spring. Readings on an arbitrary scale are proportional to the force exerted on the pin by the rubber. Also, since the spring obeys Hooke's law, the readings are proportional to the linear travel of the pin from the extended or zero position. In the second method, a constant force is applied to the pin and the linear penetration into the surface of the vulcanizate is measured. Both methods depend upon arbitrarily determined factors including the diameter of the washer, the thickness of the test specimen, the length and shape of the pin, the pressure on the washer, for the spring-actuated type the spring constant and initial setting, and for the weight-actuated type the size of the weight. Inaccuracies in hardness measurements have long been tolerated, but this situation must be improved. It is reassuring that the Society's Committee D-11 on Rubber Products is giving this matter intensive consideration at the present time and that a pronounced improvement may be expected.

Hardness measurements are an indication of modulus of elasticity of vulcanizates, but not specifically a measure of modulus. As the pin of the hardness tester presses into the surface of the vulcanizate, material directly under the pin is subjected to compression at the same time that lateral displacement of some of the material produces stress in shear. Assuming an interrelation between moduli of elasticity in compression and shear, the penetration of the pin is dependent primarily upon the modulus of elasticity of the vulcanizate in shear, but it is modified by any concurrent plastic tendencies. Since the hardness figure for a given vulcanizate depends upon a single test condition, it can be expected to correlate with no more than a single value of the shear modulus. To the extent that different vulcanizates have differently shaped stress-strain curves we may expect deviation of hardness figures from exact correspondence to shear modulus.

Having experienced satisfaction with one composition having a definite hardness, how far can one go toward expecting that another composition of the same hardness will serve as well? This depends largely upon how important modulus of elasticity is in comparison with other properties. If modulus is of prime importance, the hardness measurement may suffice; if of secondary importance, hardness is also of secondary importance.

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Exchange Agreement Provides Trade of Cotton for Rubber

Agreement Signed in London on June 23 Between the United Kingdom and the United States Concludes Long-Term Negotiations on Subject

CREATION of an American war reserve of rubber was assured on June 23rd with the signing of an Anglo-American agreement exchanging approximately 85,000 tons of rubber from British Malaya and other British possessions for 600,000 bales of surplus cotton from the United States. On July 6 the Senate of the United States adopted a bill authorizing the Commodity Credit Corporation to carry out the exchange covered in the barter agreement. Senate approval was necessary due to the fact that the agreement is recognized as a "treaty." Ownership of the American cotton, now held on loans to growers, will be transferred to the C.C.C. under terms to be prescribed by the Secretary of Agriculture.

Amount of Rubber Involved

The rubber involved in the barter agreement amounts to approximately one-fifth of the annual consumption in this country. The deal is expected to go a long way toward filling one of the most serious gaps in America's preparedness for war. With the world's rubber supply in the hands of foreign countries, principally Great Britain and the Netherlands, it has been impossible until now for the United States military authorities to accumulate an adequate reserve. Now the British Government has agreed, and, what is more important, it has promised to buy the necessary rubber from producers in the Far East.

Under the terms of the agreement, the British Government has taken upon itself the task of dealing with the International Rubber Regulation Committee, in whose hands rests the successful operation of the current restriction scheme. This is an important angle because of the fact that negotiations between the United States and the Committee in the past have always been somewhat troublesome for this country.

British Add to War Reserves

In return, England will be able to add to its war reserves by getting an amount of American cotton equivalent to approximately half of its annual consumption. The 600,000 bales of cotton involved will relieve the United States of only some 5½% of the 11,000,000 bales it now holds for the benefit of American cotton growers. To emphasize the fairness of the transaction, which involves approximately $30,000,000 each way, the agreement provides that half of the shipments in either direction shall be carried in American bottoms. Since cotton is a bulky commodity, shipment of the commodities is expected to provide a large amount of needed work for the American Merchant Marine.

Although the agreement between the two countries would seem to be an outright barter deal of the kind both governments have condemned in the past, both American and English diplomats have pointed out that the agreement could not be adequately covered by the term "barter." In this connection, they point out that the transaction will in no way interfere in the slightest with ordinary commercial trade and could not conceivably hurt the trading interests of third parties, thus differing from deals made between other countries.

The entire stocks involved will be clearly earmarked as reserves for "war emergency." There is a provision in the agreement, however, to the effect that if there is no war the stocks will be held for at least seven years. At the end of that time, if and when the stocks come to be liquidated, both governments agree to regard themselves as obliged to consult and do everything possible to avoid disturbance of markets. This clause was inserted largely to assuage British rubber interests which were concerned with the possibility that the United States could dump its reserve onto the market and thus create havoc with prices.

The price of the cotton involved in the agreement will be the average between January 1 and June 23, 1939. Delivery of the cotton, as of the rubber, will take place directly at the ports of the exporting country. Acceptance of the cotton will begin as soon as possible after the agreement enters into force and must be completed within six months. The date for acceptance of the rubber has been left to future agreement between the two governments, this move helping to prevent speculation.

Rubber Stock Will Be Rotated

While the stocks exchanged are to be held for war purposes only for at least seven years, actually the rubber will be rotated in the warehouses to prevent deterioration of stocks. It will be replaced with fresh supplies as often as deemed necessary, but only to the point of duplication. Machinery for this rotation of stocks is already being set up by the Army and Navy, both of which will have charge of the stocks as strategic war reserves.

Special credit for conclusion of the agreement between the two countries is given to Joseph P. Kennedy, U. S. Ambassador to Great Britain, and to W. W. Butterworth of the U. S. Embassy in London, both of whom personally handled many of the knotty technical problems of the deal. For the British, various members of the British Board of Trade were responsible for handling of the details.

The full text of the agreement between the United Kingdom and the United States for the exchange of cotton for rubber follows herewith:

Text of Anglo-American Accord for Exchanging Cotton for Rubber

I

The United States Government will supply to the Government of the United Kingdom, delivered on board ship, compressed to high density, at New Orleans, and at other Gulf and Atlantic deepwater ports to be agreed upon between the two governments, 600,000 bales of raw cotton of the grades and staples which will be specified by the Government of the United Kingdom. The United States Government will make available in adequate quantities for such purpose cotton from the stock on which the United States Government has made advances to growers.

(A) The price will be fixed on the basis of the average market price as published by the Bureau of Agricultural Economics for middling 7/8 inch cotton during the period Jan. 1-June 23, 1939, for spot delivery at New Orleans, plus 0.24 cent per pound for cost of compression and delivery on board ship, with adjustments in price for other grades and staples according to differences above or below middling 7/8 inch quoted in that period.

(B) The cotton will be inspected to determine its classification in accordance with the universal cotton standards for grade and the official standards of the United States for staple, and will be accepted, by experts appointed by the Government of the United Kingdom. Any disputes which may arise will be settled by Boards of Referees constituted of three members, of whom one shall be nominated by the Government of the United Kingdom.

(C) Samples representing the cotton of the grades and staples specified by the Government of the United Kingdom will be made available for inspection and acceptance during a period of six months beginning fifteen days after the entry into force of this agreement. And such inspection and acceptance will be made within a reasonable time after the cotton is so made available. Delivery at the warehouse at the port of sailing with provision for free delivery on board ship at high density will be made within fifteen days after inspection and acceptance, and storage and insurance charges will be borne by the United States Government for a period of two weeks but no more after delivery at the warehouse at the port of sailing.

(D) All cotton will be invoiced and accepted on gross weight at the time of delivery.

II

The Government of the United Kingdom will supply to the Government of the United States, delivered on board ship at Singapore and, by agreement between the two governments, at other convenient ports, rubber in bales, of the grades which will be specified by the Government of the United States, to a value equivalent to that of the total value of the cotton to be supplied in accordance with Paragraph 1 of this agreement. In determining such equivalent value, the rate of exchange between Straits Settlements dollars and United States dollars shall be deemed to be the average of the buying rate during the period Jan. 1-June 23, 1939, in the New York market, at noon, for cable transfers payable in Straits Settlements dollars, as certified by the Federal Reserve Bank to the Secretary of the United States Treasury and published in Treasury Decisions.

(A) The quantity of rubber will be calculated upon the average market price, as published by the Department of Statistics in the Straits Settlements, for No. 1 ribbed, smoked sheets, during the period Jan. 1-June 23, 1939, for spot delivery at Singapore plus 0.25 Straits Settlements cent per pound for cost of baling and delivery on board ship, with adjustments in price for other grades according to differences quoted in that period.

(B) The rubber will be inspected and accepted by experts appointed by the United States Government. Any disputes will be settled in accordance with the normal custom of the trade.

(C) The rubber will be made available for inspection and acceptance by experts appointed by the Government of the United States during a period of six months beginning at a date to be agreed upon by the two governments, and such inspection and acceptance will be made within a reasonable time after the rubber is so made available. Delivery at the warehouse at the port of shipment with provision for free delivery on board ship will be made within a period of fifteen days after inspection and acceptance, and storage and insurance charges will be borne by the Government of the United Kingdom for a period of two weeks but no more after delivery at the warehouse at the port of shipment.

III

If either government should find that delivery in accordance with the arrangements specified in Paragraphs 1 and 2 is likely to restrict supplies available to commercial markets unduly or to stimulate undue price increases, the two governments shall consult with a view to postponing delivery or taking other action in order to avoid or minimize such restriction of supplies or such price increases.

IV

The intention of the United States Government and of the Government of the United Kingdom being to acquire reserves of rubber and cotton, respectively, against the contingency of a major war emergency, each government undertakes not to dispose of its stocks (otherwise than for the purpose of replacing such stocks by equivalent quantities in so far as may be expedient for preventing deterioration) except in the event of such an emergency. If, however, either government should at any future date decide that the time has come to liquidate its stock of cotton or rubber, as the case may be, it may do so only after (a) consulting the other government as to the means to be employed for the disposal of such stock, and (b) taking all steps to avoid disturbance of the markets. In no case may either government dispose of such stocks, except in the case of a major war emergency, before a date seven years after the coming into force of this agreement.

V

The Government of the United Kingdom will use their best endeavors to secure that the export is permitted under the International Rubber Regulation Scheme of an amount of rubber approximately equivalent to the amount of rubber to be supplied to the United States Government under this agreement in addition to the amount of rubber which would under the normal operation of the scheme be released to meet current consumption needs.

VI

Each government undertakes, in shipping to its own ports the stocks of cotton and rubber, respectively, provided for in this agreement, so far as may be possible to distribute the tonnage equally between the ships of the two countries, provided that the shipping space required is obtainable at reasonable rates. Consultation for the purpose of giving effect to this paragraph shall be between the Board of Trade and the Maritime Commission.

VII

Should the United States Government, before the delivery is completed of the cotton provided for in Paragraph 1 of this agreement, take any action which has the effect of an export subsidy, they will deliver to the Government of the United Kingdom an additional quantity of cotton proportionate to the reduction in price below that provided for in Paragraph 1 of this agreement caused by such action.

VIII

This agreement shall come into force on a date to be agreed between the two governments.

Done in London in duplicate this twenty-third day of June, 1939.

JOSEPH P. KENNEDY.
OLIVER F. G. STANLEY.

Rubber Suspension*

By A. S. Krotz

Development Engineer, B. F. Goodrich Co.

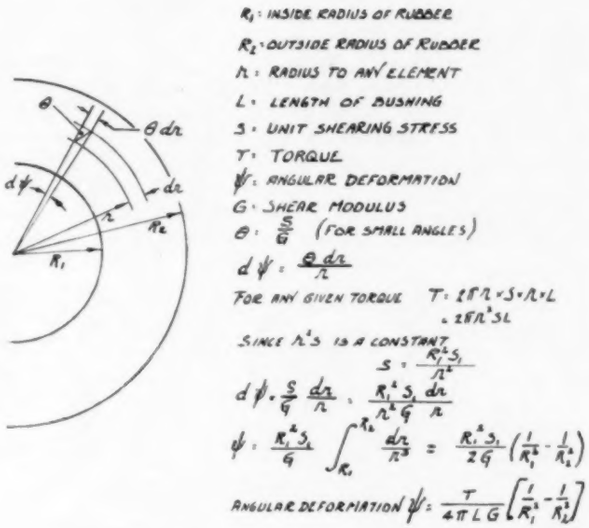
In any of the designs thus far considered there is very little exposed surface of rubber and any deterioration at these exposed ends has been found to have a negligible effect on spring life. It has not been found necessary to use a shield of any kind at the ends, and the aging of the body of rubber is extremely slow and requires longer than the total life of the car to make any appreciable change.

With some understanding of the proposed use for these springs, and of their characteristics, we can turn to more detailed problems of spring design. With the required static moment and elastic torsional rate determined, the remaining design steps can be carried out very simply. For passenger car independent suspension designs having roughly 7" to 12" static deflection and 8" wheel stroke, that is 4" compression and 4" rebound, we find that static shear stress up to approximately 130 lb. per square inch with an optimum for reduced creep at 120 lb. per square inch on the outside diameter of the bushing shaft gives satisfactory results. This figure is modified by the hardness of stock used, as discussed below. Also, an upper shear limit of 200 lb. per square inch on the bond to the shaft for 60 hard rubber should not be exceeded in the extreme metal to metal position of wheel stroke. The spring used as an example in preceding figures was designed for and tested at 122 lb. per square inch static shear and maximum wheel stroke gave 182 lb. per square inch shear.

The spring shaft can then be designed by providing for the required static moment (as transmitted through the rubber bonded to its outside diameter) without exceeding 120 lb. per sq. inch unit shearing stress on the rubber bond. The decision as to the combination of length and diameter of the bonded area will depend on the elasticity or flexibility (other than angular) desired of the bushing in its function of mounting or bearing for the suspended wheel parts and of course will depend on torsional strength of the shaft and chassis considerations.

After determining the shaft diameter and effective length over which rubber is to be bonded in order to bring the static shear stress to 120 lb. per sq. inch or any other figure decided upon, the thickness of any rubber compound required to give the desired torsional rate can be determined. Figure 10 is a section through a simple rubber torsion spring where no tie gum is used. At the lower right is a stress-strain curve for a sample of the same rubber in what is usually referred to as pure shear. That is, a rubber "sandwich" cured between flat plates is stressed by parallel movement of the plates.

Returning to the torsion spring the mathematical analysis for relating the functions of rubber thickness and spring rate is as follows:


R_1 = INSIDE RADIUS OF RUBBER
R_2 = OUTSIDE RADIUS OF RUBBER
r = RADIUS TO ANY ELEMENT
L = LENGTH OF BUSHING
S = UNIT SHEARING STRESS
T = TORQUE
ψ = ANGULAR DEFORMATION
G = SHEAR MODULUS
$\theta = \frac{S}{G}$ (FOR SMALL ANGLES)
$d\psi = \frac{\theta\, dr}{r}$
FOR ANY GIVEN TORQUE $T = 2\pi r \cdot S \cdot r \cdot L = 2\pi r^2 SL$
SINCE $r^2 S$ IS A CONSTANT $S = \frac{R_1^2 S_1}{r^2}$
$d\psi = \frac{S}{G}\frac{dr}{r} = \frac{R_1^2 S_1}{r^2 G}\frac{dr}{r}$
$\psi = \frac{R_1^2 S_1}{G}\int_{R_1}^{R_2}\frac{dr}{r^3} = \frac{R_1^2 S_1}{2G}\left(\frac{1}{R_1^2} - \frac{1}{R_2^2}\right)$
ANGULAR DEFORMATION $\psi = \frac{T}{4\pi L G}\left[\frac{1}{R_1^2} - \frac{1}{R_2^2}\right]$

The difficulty with applying such an analysis is that any equation involves the shear modulus G for the rubber compound. It is common practice to assume that G is defined by the slope of the tangent to the shear curve for small amplitudes of movement. Such a tangent is drawn on the shear curve, Fig. 10, and departs seriously from the slope of the curve in the range of actual stress.

Since every particle of rubber in the torsion spring may be thought of as an element in the thin layer *dr*, the entire body of rubber is stressed in shear, the shearing stress varying inversely as the square of the radius to the particle. This analysis is given above in mathematical form and can be used also in a graphical approximation which is fairly accurate. This has been done in Fig. 10 by assuming that the body of rubber is divided into successive layers each having a thickness equal to 5% of its inside radius.

The heavy spiral line represents the position taken under torsional deflection by a theoretical element in the rubber which is radial at no load. In each of the successive layers the distorted element departs from the radial direction by the angle of departure for that stress as obtained on the shear "sandwich."

One such graph is all that is needed for each rubber compound to cover the widest assumed range of unit static stress and torsional rate. For lower static stresses it is only necessary to move out to a new radius where the required shear stress exists and strike a new arc to represent the inside diameter of the rubber. The thickness required for any angle of wind-up is always measured in terms of per cent of that inside diameter.

Figure 11 is a section through a shear "sandwich" and a torsion spring. In the shear sample, if AB is

* Concluded from the June, 1939, issue.

ADVERTISING PAGES REMOVED

taken as an element in the rubber under no shearing stress, and the "sandwich" is then deformed by a shear movement of amplitude AC, it is customary to refer to the quantity $\frac{AC}{T}$, or the displacement divided by the rubber thickness, as the per cent of shear deformation. For large percentages of deformation the change in length of the theoretic element AB when it assumes its new position BC is sometimes called "stretch" although this is not analogous to the stretch in a rubber sample under tension.

This same analysis of "stretch" cannot be applied directly to torsion springs, since the deformation obviously varies with the stress, and the shearing stress varies inversely as the square of the radius of the particle of rubber under consideration. Table I herewith indicates the variation in shearing stress and so-called "stretch" from the inside diameter to the outside diameter of the spring used to illustrate this paper. The first two lines show the effect of tie gum in reducing stress. For the sake of comparison item #8 gives an index for *average* stretch as shown by the line bc on the torsion spring, but has no fixed relation to the maximum "stretch" at the inner diameter of the rubber as given by item #6.

In the actual application of this method to the design of torsion springs the use of some physical fundamentals permits the design engineer to cooperate intelligently with the rubber technician. Some engineers feel that there is an unwarranted amount of mystery in the designing of rubber parts. There appear to be many difficulties to overcome before it will be possible to establish standards as complete as SAE standards for steel, which will apply to a certain grade of rubber regardless of source. However, many of the factors influencing the design of rubber parts are understandable without any great background of rubber experience.

TABLE I

	Static load Car with 5 passengers	*Maximum Bump load— Metal to Metal*
(1) Unit shearing stress at shaft	122 lb./sq. in.	183 lb./sq. in.
(2) Unit shearing stress outside shaft tie gum	105 lb./sq. in.	154 lb./sq. in.
(3) Unit shearing stress at outside dia. of body of rubber	49.7 lb./sq. in.	73.3 lb./sq. in.
(4) % shear def. at (2)	210%	260%
(5) % shear def. at (3)	83%	135%
(6) % "stretch" at (4) (maximum)	133%	179%
(7) % "stretch" at (5)	30%	68%
(8) % average stretch as given by $\frac{bc - ba}{ba}$ for comparison only	44%	84%

The property that interests us most in rubber is its elasticity or ability to sustain repeated large deformations and return approximately to its previous form. A wide range of rubber parts, including these torsion springs and many other springs and mountings, require rubber compounds which are very similar except for the *degree* of elasticity. That is, the compounds used for these purposes may vary in hardness but must have low permanent set and high fatigue life under comparable stresses, together with good aging characteristics and other more technical re-

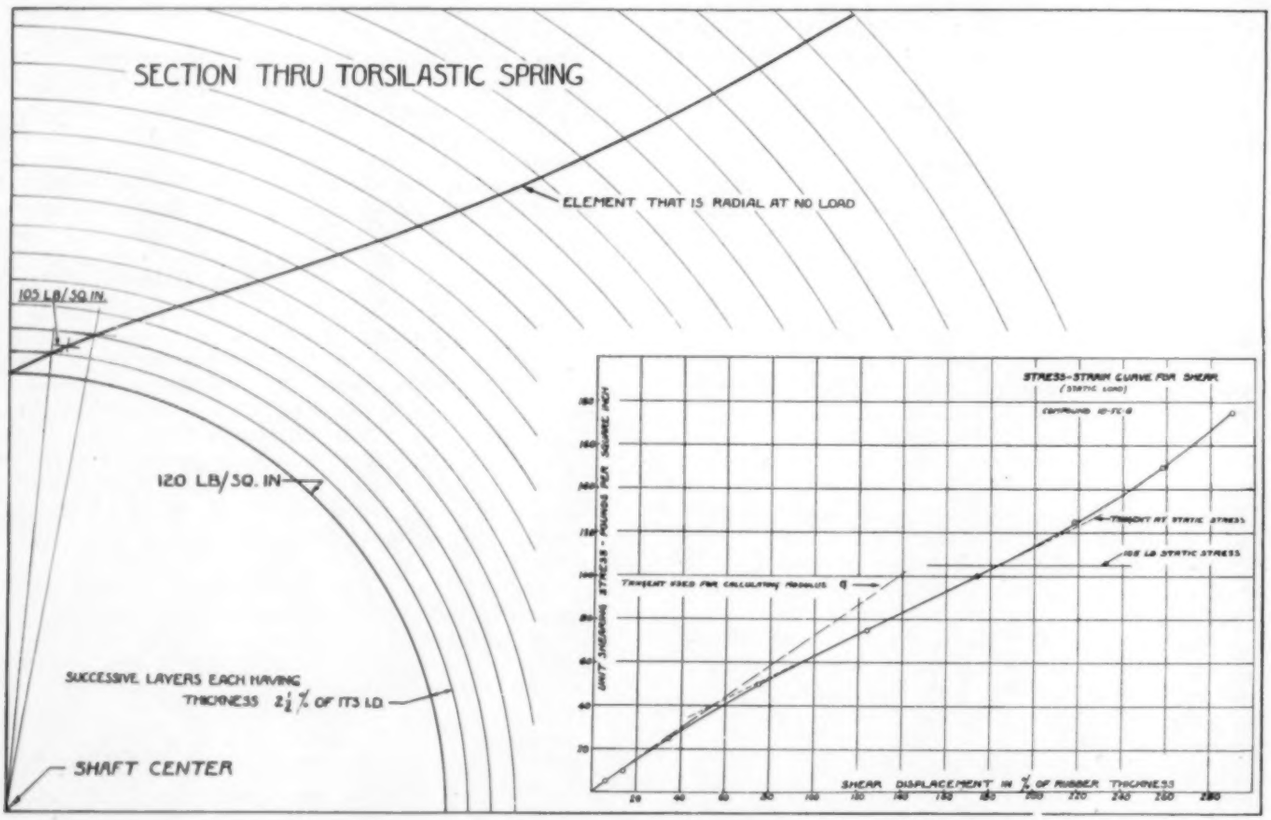

SECTION THRU TORSILASTIC SPRING
ELEMENT THAT IS RADIAL AT NO LOAD
105 LB/SQ IN.
120 LB/SQ. IN
SUCCESSIVE LAYERS EACH HAVING THICKNESS 2½ % OF ITS I.D.
SHAFT CENTER
STRESS-STRAIN CURVE FOR SHEAR
UNIT SHEARING STRESS - POUNDS PER SQUARE INCH
SHEAR DISPLACEMENT IN % OF RUBBER THICKNESS

FIG. 10

quirements. It is not necessary that such a series of compounds all bond easily to metal parts, as tie gum can be used for that purpose.

The range of acceptable stocks is limited, on the soft side, by the objectionable effect of adding large amounts of softening agents such as oil. At the present state of development a compound of pure gum stock containing only the essential ingredients for a satisfactory cure will probably be between 40 and 45 Shore Durometer hardness after cure. The hardest stock that can be used effectively will be approximately 60 Durometer for reasons which appear later.

Some system is necessary for coordinating the tests and determining the performance which should be expected from each stock. For example, if all compounds were tested for creep and for fatigue life at the same unit stress, the soft rubber deforms more than the hard rubber and stores more energy per unit volume and therefore is at a disadvantage. Conversely if all compounds were tested over the same range of deformation, the hard compound is placed under higher unit stress and it, in turn, is at a disadvantage.

Figure 12 gives two stress-strain curves, for a so-called 60 hard stock, and for a stock having 45 Shore Durometer hardness. These curves are for shear loading as most springs and mountings stress the rubber in shear. The curve at the left is for the rubber stock used in the spring illustrated in this paper and laboratory and road tests have indicated that this stock functions very well in car suspensions at 105 pounds per square inch static shear stress.

An index to the efficiency of this stock in a suspension spring can then be obtained by the area of the triangle formed under the tangent to the curve in the approximate working range. The actual work done in deflecting the spring from zero load to the static loaded position, as given by the area under the loading curve, is of less value since this type of spring is never unloaded completely, and the range of most interest is for short strokes each side of the static position.

Using this stock as a base line, in order to obtain the same efficiency from unit volume of the 60 hard stock at the right of Fig. 12 it would be necessary to draw in a nominal work triangle having the same area as in the curve at the left and having a hypotenuse tangent to the loading curve at its upper end. Such a triangle has been drawn in and establishes the required static stress for the right hand curve at approximately 140 lb. per square inch. If this stock were stressed to 140 lb. per square inch static load, maximum wheel stroke for this car would bring the stress to approximately 210 lb. per square inch. We have found it inadvisable to go beyond 200 lb. per square inch shear stress on the bond between the rubber and metal even for very infrequent strokes such as the "metal to metal" position of wheel linkage, and it is therefore not possible to use stocks this hard or harder at full efficiency.

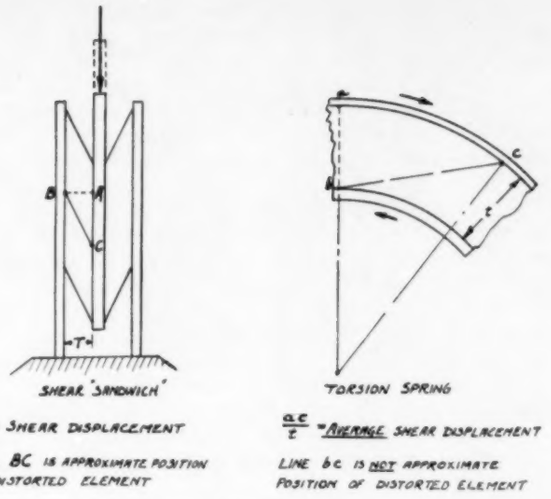


FIG. 11.

In laboratory test work a series of stocks of varying hardness can be tested at unit stresses determined for each stock by the nominal work method described. It is also possible to use the so-called shear modulus G for each stock. Static stress required of any stock can then be determined by the equation

$$\frac{S_1}{S_2} = \sqrt{\frac{G_1}{G_2}}$$

where S_1 and G_1 are the unit shear stress and modulus for some known rubber stock used as a base line. This equation gives the same results as the "nominal

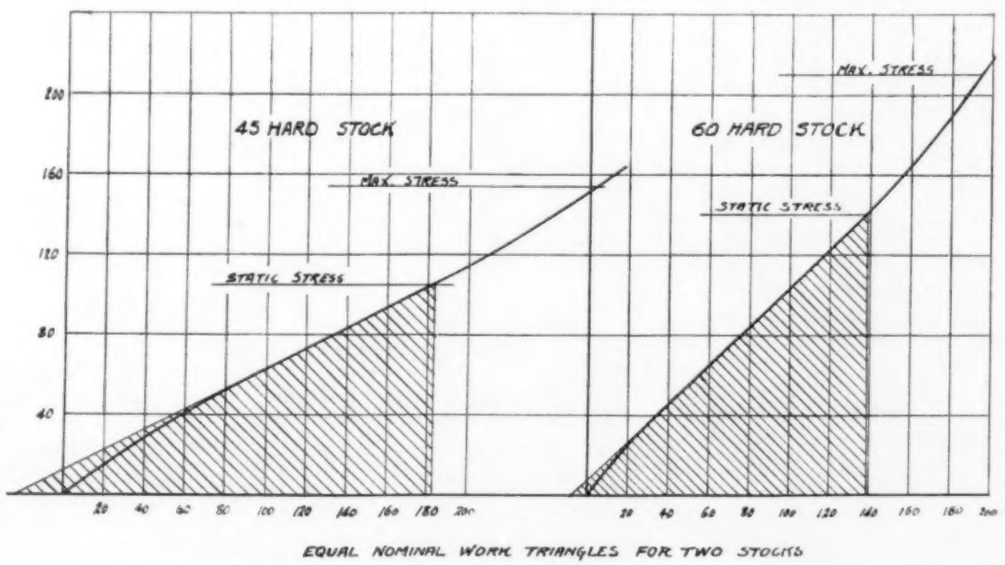


FIG. 12 — Stress-strain curves for a so-called 60 hard stock and for a stock having 45 Shore Durometer hardness. The curves are for shear loading as most springs and mountings stress the rubber in shear.

work" method described above provided the stress-strain curves for the two compounds are proportionate, which is seldom strictly true.

After determining the unit static stress at which various stocks are to be tested to give comparable results, the range of stress for fatigue tests should be some proportion of the static stress and not a fixed stroke.

By applying some system of coordinated tests, such as that briefly described here, a series of stocks which are acceptable for many forms of rubber springs and mountings can be developed. These stocks will not all have the same characteristics of fatigue life and creep and the other tests applied, and in many cases the designer will be willing to sacrifice one or more characteristics to obtain a stock of some preferred hardness or with some other particular qualification, however it is not possible to make these decisions intelligently until some such basis of comparison is established.

It is interesting to note that in actual service the maximum shear loads due to wheel stroke will usually fall on a somewhat steeper part of the shear curve, as in Fig. 12, and consequently a given angular movement in a torsion spring will cause less relative angular displacement in the highly stressed layers near the shaft than the same bushing angle would cause at lower loads. This effect seems to be of some importance in throwing relatively more deformation into the layers which are farther from the shaft and stressed less, thereby increasing fatigue life which depends not only on unit load but also on range of deformation. The net effect of this is to make the cylindrical torsion spring a more efficient method of using rubber than may appear at first sight.

Rubber torsion springs designed within the limits outlined here should be capable of many years use without any further attention or service other than a possible adjustment at long intervals. They should give improvement in ride with lowered noise level, low weight and clean design all in some proportion to the skill used in applying them to the chassis design. The factor of sales appeal is outside the province of strict engineering analysis but should also be evaluated in the overall picture.

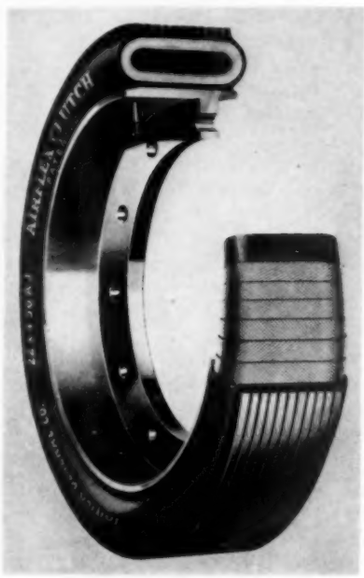
Airflex Rubber Clutch

EMBODYING the same engineering principle incorporated in the multi-vaned tread of the General Dual-8 and Dual-10 passenger car tires, the Airflex Rubber Clutch has been developed by the General Tire & Rubber Co., Akron, Ohio. Since adhesion is the principal job of a clutch, no matter where used, the new rubber clutch features a multi-vaned surface. This surface, it is claimed, clings to steel with twice the friction co-efficient of asbestos or other conventional clutch lining. Tests have indicated that in installations where the new clutch replaced conventional clutches it invariably lasted longer because it adjusts itself to the conditions under which it must operate and suffers no wear from misalignment.

The Airflex Rubber Clutch is much lighter than the conventional clutch. It also has the advantage of having only 3 or 4 parts as compared with 75 to 100 pieces in the ordinary type. Furthermore, it is self-adjusting while other clutches are not. Airflex clutches have been successfully operated for months in marine engines and oil well rigs. The 40-inch clutch is the largest made up to the present and is being used on marine engine applications, with 3,000 h.p. capacity.

Because of the flexibility in the application of its pressure, the Airflex clutch provides uniform pressure on every inch of the surface, while the pressure exerted by the plate-type clutch varies when the plate becomes only slightly warped. For the same reason, the new clutch has many of the properties of a coupling when it is engaged, and can take care of a reasonable amount of angularity and misalignment.

While the capacity of other types of clutches is fixed and is not changeable, the capacity of the Airflex



clutch is regulated by internal pressure and can be changed to conform to needs and conditions. Adhesion is obtained through the friction liners which are riveted to brass plates which are vulcanized to the clutch gland.

A complete line of Airflex clutches is being developed for industrial purposes, such as machine tools, conveyors, Diesel electric generators, and similar uses, as well as for larger applications. Two distinct types of linings are used. When excessive slippage is encountered and where loads are to be picked up gradually, the use of friction lining is recommended. When the plain rubber squeegee tread is used, a reasonable amount of slippage can be tolerated if the engagements are not too frequent. The clutches are given special treatment to prevent disintegration by oil fumes. A special rotary seal has been developed to deliver air to the clutch.

The Fawick General Company has been organized to manufacture the new Airflex clutch. Thomas L. Fawick, of Akron, Ohio, inventor of the clutch, is prominently identified with the new company, which will be affiliated with the General Tire & Rubber Company. Licenses for the distribution of the Airflex marine type clutch have been granted to the Falk Corporation, of Milwaukee, Wisconsin.

White Sidewall Tire Paint

RECOGNIZING the present upward trend of demand for white sidewall tires, the B. F. Goodrich Co., Akron, has announced a new white sidewall tire paint applicable for renewing white sidewall tires or for making present black sidewalls white. Made with a rubber base, the new paint is self-vulcanizing, is elastic and thus flexes with the tire and will not crack or chip. The new paint is applied with a brush, dries quickly, and can be washed with soap and water.

Charles Goodyear

CONNECTICUT YANKEE AND RUBBER PIONEER

By P. W. Barker

CHAPTER XVI

Achievement of Charles Goodyear

DURING his futile European trip, when his life had but eight years to run, Charles Goodyear wrote to William C. De Forest, saying that his first aim in life was to pay his debts, but that the other aim was, "the accomplishment of a great work for the good of mankind. In this last aim I need not tell you that I have been successful, as I hope to be in the other. Vast numbers of mankind already bear witness to this." The good man did not live to see his debts paid, but there is every reason to believe that his son, Charles, Jr., discharged all of them.

Inventor Aware of Achievement

Eight years before his death, Charles Goodyear was aware of his achievement and unselfish contribution to civilization. To modern civilization. No one can see a speeding automobile or witness a delicate surgical operation and remain oblivious of the role rubber constantly plays in the drama of our lives. Practically every new invention has vital parts of vulcanized rubber. It beggars the point to declare that another would have discovered vulcanization had Charles Goodyear been unsuccessful. That no man did make such a discovery in the hundreds of years the gum was known to mankind should be sufficient proof of the greatness of the achievement.

But what of Horace H. Day, against whom Goodyear obtained a perpetual injunction and damages for infringement, at Trenton, in 1852? One would naturally think that if the inventor died indebted to the amount of over $200,000 the infringer in all probability should have fared much worse!

Goodyear licensees pursued Day relentlessly, filed numerous suits, and chased him from one legal corner to another. What a worthy antagonist was this man! He appears never to have acknowledged defeat in his purpose to manufacture all kinds of rubber goods, irrespective of patent rights. In two different periods, in order to defeat his enemies, he closed down his factories. It is said that his hair turned grey over night from all his difficulties with the courts, but he persisted in his course of illegal rubber manufacture.

When Conrad Poppenhusen became the leading hard rubber manufacturer in the United States, he decided that something had to be done about Day and Day's infringement of his business. Poppenhusen was a practical business man, as was William Judson. Judson, it will be remembered, was for many years attorney for Goodyear and had accepted stock in manufacturing companies and rights in Goodyear's patents as a large part of his attorney fees, becoming a very important figure in the industry. Accordingly, these two realists, in May of 1860, formed the Goodyear Elastic Fabrics Company, for the sole purpose of purchasing Day's rubber factories and interests.

Capitalization of Goodyear Elastic Fabrics was about $500,000, of which Day is said to have received $371,000, actually paid by 1862. Two months before the death of Charles Goodyear, Horace H. Day, the acknowledged and often proved infringer, concluded financial agreements by which he received more money as a nuisance fee to desist from infringement than the inventor had realized during his sixteen years as patentee.

On May 29, 1860, Henry Bateman Goodyear, administrator of Nelson Goodyear, and Conrad Poppenhusen, owner of the L. Otto P. Meyer patents, signed an agreement with Horace H. Day, in consideration of $1 each received, to release Day from all suits and claims of damage for infringement of the vulcanization patent of Charles Goodyear, the hard rubber patent of Nelson Goodyear, and the various hard rubber patents of L. Otto P. Meyer. Not only Day was released, according to the terms of the agreement, but also Richard McMullen and John Dixon, two of his employees who had been sued after their employer left his plant in their care when fleeing from the New Jersey courts.

Day Released from Responsibility

In addition to being paid to quit the rubber manufacturing business, that is, for estoppel of infringement, Horace H. Day was assured of safety in ownership of his nuisance fee and released from responsibility of his infringement. It is believed also that Charles Goodyear found it in his generous heart to

forgive Day. Peirce says, "His last audible expression to his wife, when he was dying, was a charge to forgive a person from whom he had suffered much." None other fitted this description better than Horace H. Day.

After losing most of his wealth in an immense plan for utilizing the power of Niagara Falls, Day again threatened to enter the rubber manufacturing business and received $40,000 as an additional nuisance fee. This appears to have been his last connection with the rubber industry.

Among his other activities, Day was interested in spiritualism and supported a three-story building for this purpose at Broadway and Prince Street, New York City, in which the spirits of Daniel Webster and others allegedly gave him business counsel. He was twice divorced, paying $100,000 and $75,000 for bills of separation.

Goodyear Called "Confidence Man"

The intense antipathy Day bore Charles Goodyear reached its zenith on April 22, 1864, when as a witness before the Congressional Committee on Patents, he made this statement: "No man knew better than Charles Goodyear how to create impressions to inspire confidence, to get ahead by his ingenious declarations —regardless of truth—and to win, by his cunning, other's confidence and money. He deserves to be known as the original of the famed Confidence Man. I have myself arrived at the conclusion that no man ever lived with a more just right to the title." Charles Goodyear's widow, and his son, Charles, Jr., had appealed for an extension of the vulcanization patent. Day defeated this appeal single-handed, claiming that such extension would rob the tax-payers of $75,000,000.

Death finally came to this extremely active and capable antagonist of Charles Goodyear, on August 23, 1878, at Manchester, New Hampshire, where he is buried. Despite his being worth more than a million dollars at least twice in his life, Horace H. Day died comparatively poor, with his only claim to fame that of being the relentless infringer of the rights of others.

Discovery of gold in California in 1848 led to the increased use of rubber goods, but the Civil War, or War Between the States, offered a much greater stimulus to the new industry. The troops of the North used many rubber blankets, ponchos, knapsacks, shoes, and other equipment. In the ten months from July 1, 1864, to April 30, 1865, more than 625,000 rubber blankets and 700,000 rubber ponchos, at a cost of $6,300,000, were manufactured for the army, chiefly by the Union India Rubber Company, its subsidiary, the Phoenix Rubber Company, and its licensees, the Boston Rubber Shoe Company and the Newark India Rubber Manufacturing Company.

Prices of this equipment varied considerably: blankets, $2.55 to $5; tent blankets, $3.56 to $5.25; poncho tent blankets, $2.72 to $5.60; infantry tent blankets, $4.81 to $5.70; ponchos, $4.65 to $6.40; cavalry ponchos, $7.60. Northern army purchases in the period from May 1, 1861, to June 30, 1865, included 1,893,007 rubber blankets and 1,596,559 rubber ponchos, roughly estimated as costing $17,000,000. Blankets and ponchos of gutta-percha also were sold to the army, as were a few knapsacks of the same material.

Other rubber goods for the "boys in blue" included a large number of pontoons, manufactured by the Union India Rubber Company, the number and price of which are not known. Purchases of rubber boots and shoes amounted to more than $10,000,000. It will be seen, therefore, that the Northern army spent more than $27,000,000 for rubber goods.

The Northern navy used over $500,000 worth of mechanical rubber goods, some of the prices being: 4-ply hose, $1.62 a foot; 3-ply hose, 90c; packing, $1.58 a pound; gaskets and valves, $1.58; and tubing, 35c a foot. Also, $130,000 was spent for submarine telegraph cable. License fees on these sales would have paid the $200,000 debt of the inventor.

Litigation involving the validity of Charles Goodyear's patent for vulcanization of rubber continued long after the death of the inventor. Nine years later, as a matter of record, in December of 1869, Justice Swayne of the United States Supreme Court rendered a decision in the case of Goodyear *vs.* Rubber Co., reaffirming the decision of the United States Circuit Court of Rhode Island. Full title of the case was: *Charles Goodyear, Executor of the Last Will and Testament of Charles Goodyear, Deceased, the Union India Rubber Company and the Phoenix Rubber Company, in Equity vs. the Providence Rubber Company, Augustus O. Bourn, William W. Brown, and Edwin M. Chaffee.* An excerpt from the decision follows:

> "Since the first patent was issued there have been numerous cases of litigation involving its validity. They were earnestly contested. In every instance the patent was sustained. If the subject were never brought here before, it was doubtless because those who were denied elsewhere saw no ground for the hope of a more favorable result in this court. We have examined the question by the light of the evidence found in the record and have no difficulty in coming to the same conclusion."

Damages also were allowed by the court against the Providence Rubber Company and its affiliate, the Columbian Company, amounting to $310,757.72, being profits from gross sales of $1,899,696.78 of goods manufactured under the patent. Payment of his share of these damages practically ruined Edwin M. Chaffee who had contributed so much to the technique and machinery of rubber manufacture.

In the "Introduction" to this story, the claim was advanced that every rubber manufacturing company in the world of long existence owed its being to instruction in the technique of rubber manufacture, received at its inception, from Charles Goodyear. Little or no proof need be introduced to support this statement so far as the American rubber industry is concerned. Every company surviving the early days of the rubber industry in the United States was a licensee of Goodyear or an infringer of his process. Factory managers of all the licensees were personally instructed by the inventor. Vulcanization was essential to successful rubber manufacture.

Position of Foreign Rubber Companies

But what of foreign rubber companies? Thomas Hancock, the British claimant for honors in the discovery of vulcanization, received instruction in rubber manufacture and vulcanization from Charles Goodyear and his son during their visit to England in 1852. Hancock never visited any foreign country with the purpose of spreading the knowledge of rubber manufacture; therefore, no claim as a rubber pioneer or missionary may be made in his behalf.

Foreign rubber manufacturers were no less dependent upon the process of vulcanization for successful manufacture than their competitors in the United States. Rubber company foremen, a large number of whom were friends of Charles Goodyear and personally trained by him, were directly responsible for

the introduction of the industry in many foreign countries. Only a few of these men may be mentioned here due to space restrictions.

Henry L. Norris and Spencer T. Parmelee, under Goodyear license, established the North British Rubber Company, Ltd., in Edinburgh, Scotland, in 1855, and Isaac B. Harris, friend of the inventor, was in charge of the mechanical goods division for thirty years. Another American, Lewis L. Hyatt, was manager of the same company for ten years. John Murphy, in 1861, established the manufacture of hard rubber in Scotland. William Somerville, in 1855, founded the Liverpool Rubber Company, which was later to be influential in founding the great Dunlop organization. S. C. Moulton, of England, manufactured under Goodyear license for a number of years, having personally received instructions from Charles Goodyear.

Jared H. Canfield, friend of the inventor, was in charge of the Compagnie National, of Paris, from 1850 to 1865. Hiram M. Hutchinson, who had purchased Goodyear footwear rights for Europe, organized Hutchinson et Cie, Paris, in 1850, and Lewis L. Hyatt, of the Ford Rubber Company, was manager of the company for a number of years. Jonathan G. Stickney, under Goodyear's direction, built factories at St. Denis, France, and later at Menin, Belgium, about 1855. J. N. Reithoffer, of Vienna, oldest rubber factory, dating from 1811, received instructions from Charles Goodyear, Jr., in 1852.

Carl Maret, who established the German industry at Harburg in 1856, had learned rubber manufacture in the United States, as had L. Otto P. Meyer who founded the German hard rubber industry. Rubber manufacture in Russia became important only in 1860 when workmen and technicians were obtained from the United States.

Although not a foreign missionary in the sense of going to a foreign country, Francis H. Holton should not be forgotten in this story. Holten had worked in his teens for the Hayward Rubber Company, had worked with Goodyear and his brother in New Haven, and had himself manufactured rubber goods in New York with different partners. In 1874, when Dr. Benjamin Franklin Goodrich was searching for a technical man for his new plant in Akron, Ohio, Holton met all the necessary requirements. For years he was in charge of the sundries department of Akron's first rubber factory. In this manner, the instruction of Charles Goodyear came to Akron, the world's rubber manufacturing center.

EDITOR'S NOTE: The publication of the Sixteenth Chapter herewith concludes the series of articles which have been running under the title: Charles Goodyear—Connecticut Yankee and Rubber Pioneer. This biography of the founder of the modern rubber industry, which started in the April, 1938, issue of THE RUBBER AGE, is particularly timely since the current year marks the 100th anniversary of the discovery of vulcanization. The Biography of Charles Goodyear will be published in book form, along with a brief history of the carbon black industry, by Godfrey L. Cabot, Inc. The book is expected to be available shortly.

Upon the death of Charles Goodyear in 1860, the United States rubber manufacturing industry consisted of 27 establishments (9 in Connecticut, 5 Massachusetts, 5 New Jersey, 5 New York, 1 Pennsylvania, and 2 Rhode Island), each capitalized at about $130,000. Direct employment was given to 1,795 men and 973 women, with annual wages of $794,570. Output of the rubber industry in 1859 was valued at $5,642,700, which compares with $3,024,335 in 1849. Each year witnesses new applications of the vulcanized rubber of Charles Goodyear to man's needs, and in this year of 1939, one hundred years after the discovery, the value of rubber goods produced in the United States will approximate $1,000,000,000.

One hundred years ago a poverty-stricken inventor was confronted with the problem: How to stop the process of charring at the right point. Imagine how much civilization would be retarded if Goodyear had never approached that problem. One has merely to visualize a modern world without vulcanized rubber. Subtract the commodity from our lives and the result would be, to us, catastrophic.

As the great inventors of the past, those benefactors of mankind, take their place in our modern judgment of their achievements, a small, sickly, bright-eyed individual, on crutches, hesitantly shuffles to the very front row. He is Charles Goodyear—Discoverer of Vulcanization.

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Crystex Insoluble Sulfur

INSOLUBLE sulfur, sold by the Stauffer Chemical Company, Inc., 420 Lexington Ave., New York City, under the trade-name of "Crystex," is a type of sulfur which has been prepared especially to prevent bloom in uncured rubber stocks. Ordinary, or soluble, sulfur in any rubber stock will be absorbed by the rubber to the extent of approximately 0.8%, depending on the quality of the crude rubber used. Beyond this amount, according to Stauffer Chemical, any excess of ordinary sulfur in the stock will be free to migrate, and tend to bloom-out on the surface. Since insoluble sulfur does not dissolve in rubber, it will "stay put" at temperatures usually prevailing during storage periods.

According to a technical bulletin issued by the company, the insoluble property of Crystex Insoluble Sulfur in uncured rubber stocks in no way alters the desired functioning of the sulfur during and following vulcanization. The reversion to the active soluble form occurs at usual curing temperatures. Insoluble sulfur is guaranteed to be not less than 90% insoluble in carbon bisulfide at time of shipment, thus providing a like high degree of insolubility in rubber. It is bright canary yellow in color, of very fine particle size, and is free flowing under ordinary conditions.

To insure the prevention of bloom in uncured stocks, Stauffer recommends that ordinary sulfur be entirely replaced by insoluble sulfur. However, to reduce costs, it would be safe to employ as much as 0.75% of ordinary sulfur, based upon the rubber content. In figuring this percentage, the soluble content of the insoluble sulfur must be taken into consideration.

The insoluble product is said to be less subject to severe lumping than ordinary sulfurs. However, to guard against poor dispersion in the stock, and the crystalline agglomerates which would result in the stock when cured, it is suggested that the sulfur be sifted through a 40-mesh sieve just before use, or even directly into the stock during milling.

Tire X-Ray Device

INCORPORATING X-ray principles, a new device which enables motorists to determine for themselves the safety and dependability of the tires they are using on their cars, has been introduced by the Firestone Tire & Rubber Co., Akron. For the present, the device is being restricted to use by Firestone dealers in this country. No pictures are taken by the new instrument, but the operator looks directly through the tires without removing them from the wheels of the car.

Exposed through the Tire X-ray machine, nails, broken cords, glass and bruises stand out as clearly visible as smudges and cracks on a pane of window glass. In an experimental test, Firestone engineers X-rayed the tires on 100 automobiles. The new device revealed that 99% of these cars carried one or more hidden tire dangers.

Detection of these under-cover hazards with the Firestone Tire X-ray is a simple procedure. The automobile is elevated several inches above the floor and the device is rolled under one wheel. Protective flaps are adjusted to confine the rays to the section of the tire being inspected. The operator turns a crank which rotates the entire wheel. When any foreign object or defective section of cord is revealed, it is immediately spotted, automatically marked, and the inspection continues. Once located, the objects are extracted.

The accompanying photograph shows Leonard K. Firestone, trade sales manager of the Firestone Tire & Rubber Co., operating one of the new devices.

Night view of the Firestone exhibit which covers three and one-half acres at the New York World's Fair.

Rubber at the New York World's Fair

THE FIRESTONE EXHIBIT

ENTERTAINMENT and diversion join hands with scientific and educational demonstrations to make the exhibit of the Firestone Tire & Rubber Company one of the most attractive to the visitor at the New York World's Fair. The exhibit embraces a tire production line, a typical farmyard, the famous Firestone singing color fountains, a product hall in which a multitude of rubber and plastic products are on display, a replica in miniature of the company's rubber plantation in Liberia, and several immense murals.

The complete Firestone exhibit covers three and one-half acres. The exhibition building itself is a striking example of the modern school of architecture. Built in the form of an "L", it has a huge rotunda entrance at the intersection of two wings, while a massive vertical fin towers 100 feet in the air. The fin forms a background for electric signs which can be seen for several miles, as well as from practically any point within the Fair grounds. Three flying horizontal fins on one side of the building are symbolic of modern day speed in transportation. The building was designed by George W. McLaughlin.

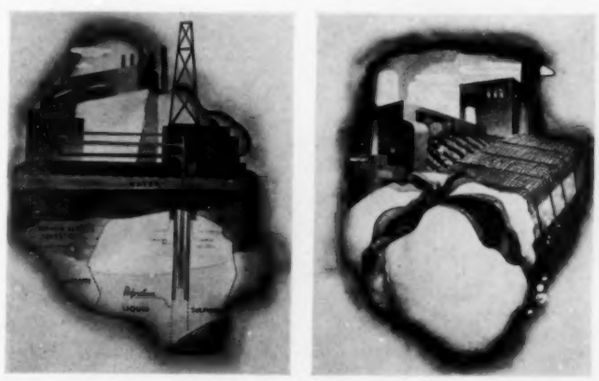
Entering the huge rotunda the visitor is faced with a replica of the Firestone factories at Akron. Five murals in the lobby depict important raw materials used in the manufacture of tires. These murals, done in oil by Daniel Boza, Cleveland artist, are each 18 feet square and deal with the mining of sulfur, the growing of cotton, the manufacture of rayon, the production of carbon black, and the use of chemicals.

At the far end of the lobby is a large diorama of the Liberian plantation. The diorama is an elaborate, animated picturization of the production of rubber. The life-like, animated scene shows how the natives tap, collect, coagulate, sheet, smoke and dry rubber. The rhythmic throb of tom-toms adds realism to the entrancing scene. Intricate machinery supplies the action for this life-like diorama which does an effective job of acquainting the public with many basic fundamentals in the cultivation of rubber.

The main wing of the exhibition building houses a complete tire production line where a finished tire is produced every four minutes. Visitors' galleries, arranged in tiers, accommodate hundreds at a time and afford an unobstructed point of vantage. As each step in the production of the tire is accomplished, narrators explain the process. Moving along with the production processes, the visitor is given a clear insight into tire manufacture.

Although hardly resembling actual tire manufacturing conditions as practiced in tire factories, since white-attired attendants operate gleaming, chromium-finished machines of ultra modern design, the Firestone tire production line at the Fair follows step by step actual manufacturing processes. Even though the various steps are fundamental to members of the rubber industry, we are recording them herewith for the benefit of those not fully acquainted with Firestone's methods.

The first step, of course, is that of compounding the rubber. A Farrel-Birmingham mixer is in use. In the next operation, that of gum-dipping, the public is



Two of the five murals in the lobby of the Firestone exhibit which depict raw materials used in the manufacture of modern tires.

MIXING

GUM DIPPING & CALENDERING

PLY CUTTING

shown for the first time the new process developed by the company. Cotton cords, in which the fibres are tightly interwoven to provide cooler running and greater strength, are locked together to form the new "Safety-Lock" cord body. The new process is said to reduce fibre slippage and frictional heat.

After being dipped in rubber, the cord fabric, in wide strips, is passed through Farrel calenders and then moves on to a ply-cutting machine where it is accurately cut to the desired width and bias angle. The plies are delivered to the tire building machine where they are so assembled that the cords in each succeeding ply run on the opposite angle to give balanced strength. The first two plies are formed to the building drum and the beads are automatically applied.

When the complete cord body is formed, two extra layers of "Safety-Lock" cords are placed under the tread to provide an inseparable bond between the tread and the body. This feature, according to Firestone, gives greater strength to the finished tire and provides greater protection against punctures. Chafers are then applied, after which the tread and sidewall are attached as a unit. A roller underneath the tire drum securely rolls the tread and plies together and the edges of the plies are snubbed around the bead. The splices are then rolled and the tire is removed from the drum, ready for vulcanization.

As the visitor watches, the inside of the tire is treated with a mica solution to facilitate adjustment of the air bag which is inserted on a forming machine. The tires are then placed in the molds. There are ten molds, all products of the Akron Standard Mold Company, at the exhibit. The tires remain in the molds for approximately 40 minutes and are subjected to a temperature of approximately 300° F.

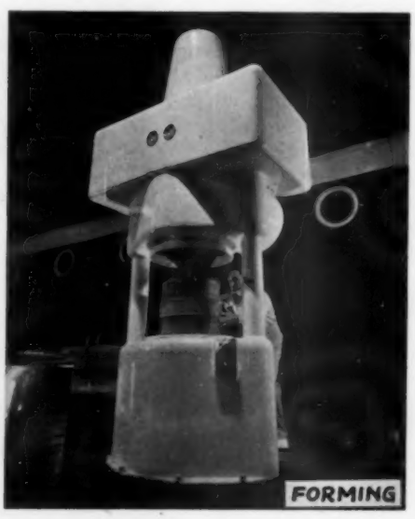
After removal from the mold, the tire is placed in an air bag removing machine and then it is trimmed and balanced. Inspectors carefully and minutely examine each tire. The final step is the wrapping operation, performed on Pierce wrapping machines. Some of the tires made at the Fair are shipped to dealers in the Metropolitan New York area, while others are sent to the Akron warehouses.

Leaving the Firestone "factory," the visitor enters the Product Hall. Here the diversity of the company's manufacturing activities is well illustrated. Tires of all sizes are on display, ranging from juvenile and motorcycle tires to passenger, bus, truck, airplane, tractor and huge tires for earth-moving equipment. The new Airtex mattresses are shown, as are seats for buses, automobiles, trains and theatres made of the same latex-whipped material.

Of special interest is the first public display of the new Firestone rubber tie plate, designed to isolate vibrations of wheeled traffic in subways. Not only does this tie plate contribute to the comfort of passengers by smoothing the ride and by reducing noise, but it is expected to result in the reduction of maintenance costs

BUILDING

PREPARING FOR FORMING


FORMING

of roadbeds and rolling stock. The new rubber traffic lane markers recently perfected by the company are also in evidence.

Various articles of clothing, including women's foundation garments, negligees and underwear, as well as vari-colored bathing suits, all made of "Controlastic" thread, in which rayon, cotton or silk is combined with rubber, are on display. Many products made by Firestone's method of mechanically bonding rubber to brass-plated metal are seen, as is a variety of mechanical rubber goods, including garden hose, industrial mountings, brake linings and automotive parts and accessories.

A wide variety of plastic commodities manufactured by the company are also on exhibit. These include such items as hardware knobs and handles, instrument panels for automobiles, and evaporator doors for refrigerators. Most of these plastic products are produced in the new Firestone factory at Wyandotte, Michigan. A number of other products, including stainless steel beverage containers, parts for fans, air conditioning units, washing machines, and other household appliances, meet the visitor's eye in Product Hall.

To stress the growing importance of rubber to agriculture, Firestone has created a typical American Farm to round out its exhibit. Nothing has been overlooked in this reproduction of American life. There are specially constructed farm buildings, such as the silo, milk house, chicken coop, corn crib, wagon sheds, barn and farmhouse. In the barnyard there is a windmill, while near the porch of the house is an outside dinner-bell to call the "hands" from the field.

As Fair visitors stroll down fence-bordered lanes they see all kinds of wheeled farm implements—threshers, plows, planters, tractors, manure spreaders, potato diggers, cultivators, sprayers, binders, mowers, combines, hay wagons, wheelbarrows—all equipped with pneumatic tires. To make certain residents of large cities know the names of these farm implements, every one on exhibit bears a descriptive label.

To carry out the theme, a stream runs through the farmyard. Ducks paddle their way along this stream and bullfrogs may be seen leaping from rock to rock. To lend an aura of distance to the rustic atmosphere, a vast cyclorama, fully 30 feet high, forms a background of waving grain fields, woods and winding roads over rolling hills. Cows, horses, sheep and goats, chickens and geese, and various livestock and fowl stroll through the barnyard, all lending a truly rural air to the farm. H. S. Breckenridge, a real dirt farmer from Meadville, Penna., is in charge of this portion of the exhibit.

The amount of work and care which went into the Firestone exhibit at the Fair may best be appreciated by the knowledge that more than 20,000 plantings were made on the three and one-half acre grounds. Apple, plum, wild cherry and pear trees, each fruit-bearing in season, were planted in the farmyard. Grape vines grow over the arbor at the back porch of the farmhouse. Elderberry and huckleberry bushes are also in evidence.

More than 100 trees dot the landscape, some of the cedars ranging 35 feet in height. A dozen tall silver maples form the background of the singing color fountains. Weeping willow grow along the creek that runs through the farm. A huge "F", 16 feet high and formed with red leaf barberry, is located at the exit of the exhibit. On one side of the ground 3,500 tulips form a mosaic design of the tread of a Firestone farm tire.

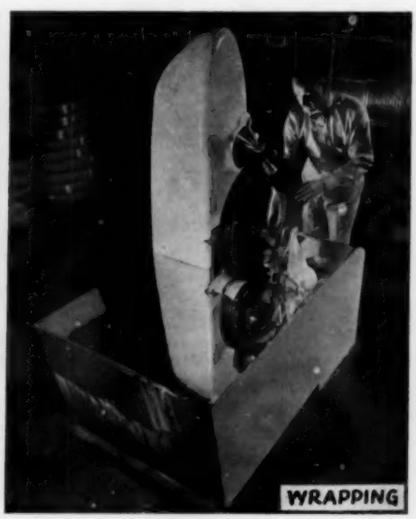
Aside from trees, shrubbery, hedges and flowers, there was also the problem of sodding. For this purpose, about 2,000 yards of Washington strain creeping bent was shipped from Akron. Another 2,000 yards of blue grass sod, on which animals in the farmyard graze, also was transplanted and approximately 15,000 square feet of ground was seeded. Special soil was of course hauled to the exhibit site for flower beds, while fertilizer, lead arsenate and peat moss was used in quantity. Concentrated plant food is being used to assist the trees in their development.

The Firestone Singing Color Fountains, which have previously been exhibited at Chicago's Century of Progress and Cleveland's Great Lakes Exhibition, continue to attract and amaze huge crowds. Jeweled plumes of spray shoot high into the air in perfect synchronization with tonal variations of music. Misty fountain domes, comprising 6,000 jets, rise majestically from a pool set in a formal garden, surrounded by lawns and flowers, shrubs and trees.

In each of the fountains a battery of colored lights automatically causes the water to change from red to pastel shades of green and blue in harmony with the various musical tones. As the intensity of sound increases there is an automatic change of the colored lights. Low musical tones produce a red lighting effect, high tones produce blue, with green and amber in between—a full scale of colors. A total of 15,000 gallons of water is used per minute. No visitor to the Fair can afford to miss the Firestone exhibit.

VULCANIZING

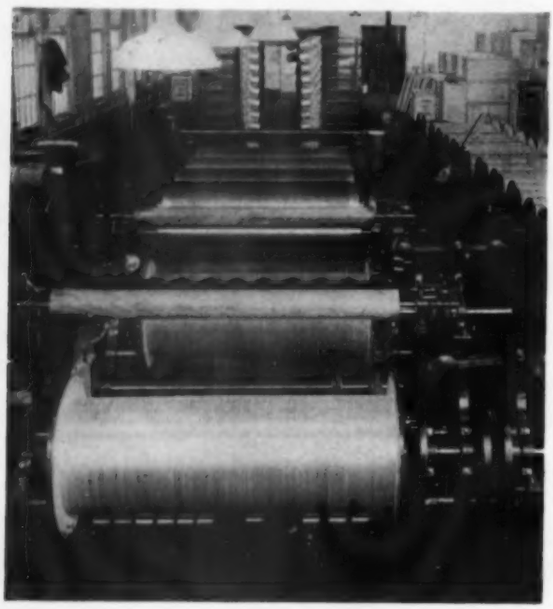
INSPECTION


WRAPPING

New Equipment

Impregnating Machine for Tire Yarn

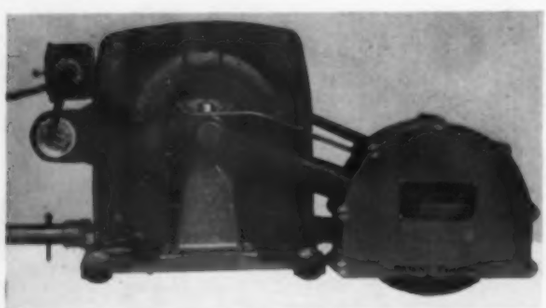
THE firm of Charles B. Johnson, of Paterson, New Jersey, has developed a machine for the treatment of rayon yarns intended for use as tire cord. The machine is actually the company's regular seven-cyl-



inder rayon warp sizer, with special modifications. Sizing strengthens the yarn and impregnates it before it is plied into cord, which is then impregnated with rubber. The machine is operated on heavier denier yarns at an average speed of 150 yards a minute. About 400 ends are treated at a time, the yarn being taken direct from a high-speed cone creel to the quetsch and then over the drying cylinders to the beam. One or more cotton section beams are carried at the specially designed take-up end. The beams in the reproduction above are 54 inches between flanges and 28 inches in diameter.

Corrugated Plate Cleaning Machine

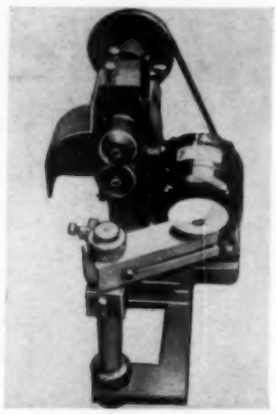
DESIGNED to operate within the press opening and thus avoid the necessity of removing the plates from the press, a new machine for cleaning cor-



rugated plates or molds has been developed by the Spadone Machine Company, 122 East 25th Street, New York City. The wheels which support the machine are flanged and track in the plate corrugations, assuring travel in a straight line. The machine consists of a bed plate fitted with wheel upon which is mounted a 1 h.p. motor and members supporting a wire buffing wheel. The buffing wheel is held in contact with the plate under spring pressure, spring tension being adjustable to suit conditions. The arm supporting the wire wheel is reversible and so constructed that it permits all sections of the plate to be reached and cleaned. The new cleaner is 19¼ inches in width, 10¾ inches in height, and weighs 110 pounds. The wire buffing wheel is 6 inches in diameter, with a 2¾-inch face, and is driven by a V-belt. These dimensions can be altered to meet existing conditions. The machine will thoroughly clean without danger of scratching or marring the plates, according to the manufacturer. In operation, it is pulled back and forth the length of the press by means of ropes. It is furnished complete with extension cable and ropes.

Spadone Bench Trimming Machine

A NEW bench trimming machine suitable for trimming mechanical rubber goods, either circular or straight, as well as odd shapes, has been introduced by the Spadone Machine Company, 122 East 25th Street, New York City. Sturdily constructed, the machine has two specially designed knives which do the trimming. These knives can be easily and quickly removed for resharpening or replacement. The new bench trimmer



is driven by a 1/20 h.p. motor. When circular material is to be trimmed, the products are placed on a revolving disc fitted on an arm which is manually swung in contact with the revolving knives. Where straight material is involved, a flat plate, which can be set at any angle, takes the place of the swinging arm. Other devices can be used, depending upon the size and shape of the material to be trimmed. The new machine is said to be particularly adaptable for the trimming of rubber tire valves.

Non-Metallic Molded Bearings

IMPROVED non-metallic bearings containing a new material known as "Gatke Tuftex" have been announced by the Gatke Corporation, Chicago, Ill. The use of the new material is said to result in bearings of long wearing qualities and much lower friction than ordinary non-metallic bearings. The new bearings are molded under terrific pressures, producing a molded bearing surface that approaches the hardness of steel, yet cannot score journals. The dense but resilient structure is said to withstand pressures and shocks that reduce the life of metallic bearings.

Booklets, Catalogs, etc.

More Information for Employees Regarding Their Company. Policyholders Service Bureau, Metropolitan Life Insurance Co., New York City. 8½x11 in. 52 pp.

This report supplements the study issued by Metropolitan Life last year on the increasingly popular device of presenting annual reports of operations to employees in a form easily grasped by those not familiar with the accounting terms generally used in stockholders' reports. (See review of "Reporting to Employees on Company Operations," THE RUBBER AGE, September, 1938). The present study discusses the efforts many organizations are making to give their employees a wider general knowledge of company problems, plans and policies. Such questions as "What do employees want to know about their company? What should they know? What are successful media for presenting this information?" are answered in the report by the opinions and experiences of executives of more than 160 companies, including several in the rubber industry.

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Significance of Accelerated Aging Tests for Rubber. (Report No. 39-4). By Arthur M. Neal. Rubber Chemicals Division, E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware. 6¼x9¼ in. 12 pp.

This report is devoted to a survey of the various accelerated aging tests, including the Geer Oven Aging Test, the Oxygen Bomb Aging Test, the Modified Oxygen Bomb Test, and the Air Pressure Heat Test. The causes of deterioration on aging are discussed, as are the fundamental requirements of an accelerated aging test. The scientific background for the development of an accelerated aging test is also given consideration. As indicated by the title of the report, the author stresses the significance of the tests.

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Operators Handbook—1939 Edition. B. F. Goodrich Co., Akron, Ohio. 4x6½ in. 96 pp.

Larger than any previous edition, the Goodrich 1939 Operators Handbook provides information for the user of all types of tires other than those for passenger cars. Various sections discuss tire problems in general, the importance of cord construction, the need to fit the tire to the job, the company's line of bus and truck tires, tires used on commercial tractors, specifications for industrial tires and the wheels on which solid tires for this purpose are vulcanized, etc. Data on load ratings and inflation pressures for tires in commercial service is included, as are tables on tires, rims and dual spacing, load and service diagrams, and other valuable information.

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Rubber Equipment in Modern Farm Management. By D. N. McHardy. British Rubber Publicity Association, 19 Fenchurch St., London, E.C. 3, England. 5½x8½ in. 20 pp.

Prepared by the Chairman of the Tractor Users' Association, Ltd. (of England), this booklet is the eleventh in the series of bulletins on the uses of rubber in agriculture issued by the British Rubber Publicity Association. As indicated by the title, the uses of pneumatic tires on modern farm vehicles of all types are illustrated and described. Copies of this booklet may be secured in this country from the Crude Rubber Development Bureau, Munsey Building, Washington, D. C.

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Centrifugals—by Sharples. Sharples Corp., 2336 Westmoreland St., Philadelphia, Penna. 8½x11 in. 20 pp.

Printed in three colors, this booklet differs from the usual in that it is not written from the manufacturer's point of view but rather from the angle of the user. General processing and research problems are divided into seven specifications, with solutions given to each specific problem. The various types of centrifugals made by the company are illustrated and described.

Belting Biographies. Mechanical Goods Division, U. S. Rubber Co., 1790 Broadway, New York City. 8½x11 in.

A novel method of cataloging U. S. Rubber's transmission and conveyor belts is used in this booklet. Instead of merely cataloging the various belts in the conventional style, case histories, dramatically illustrated, are employed. Installations of all kinds, both large and small, are depicted. In addition, the booklet contains much technical information, including data on the selection of the proper belt, installation, speed of operation, pulley size, tension, carrying capacity, etc. Suggestions for improving belting methods are also included.

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Rubber and Latex in Furnishing and Decoration. (A Reprint). British Rubber Publicity Association, 19 Fenchurch St., London, E.C. 3, England. 9¼x12½ in. 28 pp.

Reprinted from a recent issue of the *Furnishing Trades' Organiser*, this booklet traces the growing use of rubber and latex in the furnishing and decoration arts. Uses in the home, public buildings, ships, stores and theatres are described and capably illustrated. There is also a section devoted to a description of the raw material. Copies of the booklet can be secured in this country from the Crude Rubber Development Bureau, Munsey Building, Washington, D. C.

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Standard Highway Safety Program for States. Automotive Safety Foundation, 366 Madison Ave., New York City. 6x9 in. 24 pp.

Each of the seven fundamentals essential to a good highway safety program is discussed in this booklet, i.e., legislation, motor vehicle administration, enforcement, engineering, education, training personnel and research. The proper application of these fundamentals, of course, rests with the administrative heads of the respective states of the Union. The booklet should prove of specific interest to those concerned with and interested in national safety on the highways.

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Current Trends in Chain Store Taxation. Carl Byoir & Associates, Inc., 10 East 40th St., New York City. 6x9 in. 24 pp.

A clear, concise picture of current trends in chain store taxation is given in this informative booklet. Such angles as state chain store tax laws, the Patman chain store tax bill, and resolutions opposing punitive taxes are discussed. The booklet, which should prove of interest to all executives concerned with distribution through chain stores, represents the first factual "box score" presented on the current status of chain store taxation.

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Foxboro Pyrometers and Resistance Thermometers. (Bulletin 773). Foxboro Co., Foxboro, Mass. 8½x11 in.

Brief descriptions of several of the more familiar instruments in the company's line of pyrometers are given in this folder. Instruments described, and illustrated, include: Potentiometer Indicating Recording Controller, Potentiometer Recording Pyrometer, Stabilog Potentiometer Controller, Mono-Pivot Type Indicating Pyrometer, and Key-Switch Cabinet Indicating Potentiometer.

Book Reviews

Leather Finishes. By J. S. Mudd. Published by the Chemical Publishing Co., Inc., 148 Lafayette St., New York City. 5½x8½ in. 116 pp. $4.25.

The primary object of this book is to give the users of all types of finishes some information on their composition, the raw materials used in their manufacture, and the methods by which they are produced—an object which the author thoroughly succeeds in accomplishing. The book has eight chapters, in addition to a foreword by M. C. Lamb and a complete subject index. In the rubber industry, manufacturers of artificial leather will find the book of some value.

Editorial Comment

Goodyear's Biography

WITH this issue, we conclude the series of articles which have been running in biographical form on the life of Charles Goodyear—discoverer of vulcanization and truly the "Father of the Modern Rubber Industry." This biography, which has been running serially since April, 1938, was particularly timely in view of the fact that the current year marks the 100th anniversary of the discovery of vulcanization. Proper tribute to this anniversary—and to the inventor—will be paid by the American Chemical Society at its meeting in Boston next September.

It is with gratification that we are able to announce that the Biography of Charles Goodyear, taken from the pages of THE RUBBER AGE, together with new material since unearthed by the author, will soon be made available in book form by Godfrey L. Cabot, Inc., one of the country's leading suppliers of carbon black. We also wish to take this opportunity of congratulating the author, P. W. Barker, Business Specialist on Rubber and Rubber Manufactures of the Leather and Rubber Division, Washington, D. C., on a job well done.

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Anglo-American Barter Trade

THE agreement between the United States and the United Kingdom providing for the exchange of 600,000 bales of cotton for approximately 85,000 tons of crude rubber, full details of which appear elsewhere in this issue, was signed over the strenuous objections of British rubber producers. The principal concern of these producers was the fear that the United States could dump any part or all of the rubber involved onto the market and thus create havoc with the price structure. Then, too, they probably also feared that the rubber stored in this country would act as a buffer stock and thus keep prices down.

Although it still remains to be seen whether British rubber producers are mollified, the agreement includes several safeguards with respect to the price of rubber. In the first place, the rubber stocks will be earmarked as reserves for "war emergency." In the second, there is a provision in the agreement that if there is no war the stocks will be held for at least seven years. And, finally, in the third, if and when the stocks come to be liquidated both governments bind themselves to consult and do everything possible to avoid disturbance of markets.

Signing of the pact threw another major problem into the lap of the International Rubber Regulation Committee. There is little doubt that some opposition to the shipment of rubber from British rubber producing countries outside of permissible quotas will be voiced by non-British producers. Fortunately, under the terms of the agreement, the British Government will deal with the Committee and, moreover, has promised to buy the rubber from producers. The United States has been none too successful in its direct dealings with the Committee.

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Avoid Tire Price Wars

FOR the past three years or more, the tire industry has successfully avoided price wars of any kind, with the result that more tire manufacturers are making money than ever before. Therefore, it was unfortunate that the recent July 4th Holiday should have been the occasion for the release of so-termed "bargain" advertisements which were actually cut-price offers. It is always difficult to determine just with whom or where these price-cutting tactics begin.

It has been fairly well established by this time that the advertisements in question offered "50% savings" but the list prices indicated were those discontinued some time ago and were not list prices now in effect. In a few instances, tire dealers banded together and filed suits against tire manufacturers seeking damages and asking injunctions against "unfair competition." No matter where the blame lies, it is to be hoped that the instigators think better of their actions and permit the industry to return to the sane merchandising policies which have been in effect for the past few years.

CURRENT • NEWS
of the Rubber Industry

JULY, 1939

Forty-Second Annual A.S.T.M. Meeting Is Held in Atlantic City, June 26-30

Committee D-11 on Rubber Products Makes Its Report; Three Proposed Standards Accepted as Tentative; New Technical Committee on Automotive Products Announced

WITH more actions being taken on standards than at any other meeting and with a registered attendance of members, committee members and visitors second only to the meeting in New York two years ago, the Forty-second Annual Meeting of the American Society for Testing Materials was held in Atlantic City on June 26 to 30. The registration of 1,354 was higher than for any other meeting and exceeded only by the attendance of 1,523 at New York in 1937, the latter figure being augmented by a larger than the average number of visitors.

Throughout the week of the meeting, there were about 225 meetings of committees and in the 22 sessions (including several round-table discussions) some 110 papers and reports were presented. The program was unique in having so many round-table get-togethers covering effect of sub-atmospheric temperatures on metals, methods and technique of spectrochemical analysis, freezing-and-thawing tests, etc.

Many Recommendations Expected

Since this is the year when the Society will issue its triennially-published Book of Standards, it was expected the intense activity of committees would result in many recommendations. All told, some 116 existing tentative specifications were recommended for adoption as standard, and revisions of standards which had been published previously for consideration are to be referred to letter ballot for adoption in 101 standards. These figures are more than three times the corresponding statistics for 1938 and exceed by about 50 per cent the last comparable year, namely, 1936.

Despite activity on standards, there was very little diminution in the number of new specifications and tests recommended for publication as tentative. This figure of 62 has been exceeded only by the 1938 figure of 71. A chart displayed during the opening session of the meeting showed the very decided upward trend in the Society's standardization activities.

Three items were included in the session of concern to the field of rubber, including the report of Committee D-11 on Rubber Products. Three proposed standards were accepted as tentative covering rubber sheath compound for electric cords and cables, test for indentation hardness of rubber by means of the Pusey & Jones plastometer, and methods of testing hard rubber products. In the development of the first-named specification a number of problems confronted the committee and particularly the difficulty of finding suitable tests to measure resistance of the rubber sheet to abrasion and tearing. It is to be noted that these specifications include requirements covering age deterioration and resistance to tear, although the question of resistance to abrasion has had to be omitted for the present except as indirectly covered by requirements for minimum tensile strength.

The Pusey and Jones method is very generally in use in the paper industry in connection with rubber-covered rolls and similar products and has also found wide application in other fields, being required in many specifications promulgated by the Federal Government. While it might be considered desirable for purposes of standardization to try to induce all users of indentation tests to follow the present Standard Method D-314, this does not seem practical at the present time in view of the familiarity in some industries with the use for many years of the Pusey and Jones instrument. Since it is recognized that this instrument will continue to be used and, in some cases, has certain advantages, it has seemed desirable to the Committee to provide a standard procedure for conducting tests employing it.

Three New Rubber Standards

Three existing tentative standards were recommended by Committee D-11 for adoption covering sample preparation for physical testing of rubber products (D-15), test for adhesion of vulcanized rubber (friction test—D-413), and test for adhesion of vulcanized rubber to metal (D-429).

Also included in the report was the announcement of the organization of a new technical committee entitled Technical Committee A on Automotive Rubber Products. It was felt that the time was ripe for concentration specifically upon development of automotive rubber standards as suggested by the Society of Automotive Engineers. It is also believed that their proposals will insure better cooperation of the automotive engineers than has been obtainable in the past.

The Advisory Committee has, therefore, proposed that the project of developing automotive rubber standards be centralized in a technical committee, of which the personnel will be drawn jointly from the present membership of Committee D-11 and representatives of the major consuming interests in the automotive industry as recommended by the S.A.E.

Yerzley Presents Two Papers

Two papers by Felix Yerzley of E. I. du Pont de Nemours and Co., Inc., were presented, one covering a new oscillograph for routine tests of rubber and rubber-like compositions intended for cushioning services, and the second paper covering discussion of properties of rubber revealed by mechanical tests. In this latter paper Mr. Yerzley mentions that some tests are intended to measure not one but a group of physical properties associated by a particular application. The tests conceivably throw considerable light upon the usefulness of rubber in that application and lead to marked improvements of performance by changes in compounds and mechanical design. (Note: This paper is reproduced elsewhere in this issue.)

Testing Equipment Displayed

In conjunction with the meeting, the Fifth Exhibit of Testing Apparatus and Related Equipment was held. A large number of new items were displayed in this exhibit for the first time. Several Society committees and a number of government and research institutions participated with special displays. Companies displaying commercial exhibits included the American Instrument Co., Baldwin-Southwark Corp., Federal Products Corp., Tinius Olsen Testing Machine Co., Henry L. Scott Co., and the C. J. Tagliabue Mfg. Co.

SCENES AT THE AKRON RUBBER GROUP'S OUTING

1—Art Warner (C. P. Hall) inspecting a poster on the bulletin board describing his prowess. 2—R. B. Brewer (Mansfield) and John H. Rollins (Master) talking it over. 3—Walter P. Voth (Akron Standard Mold) about to use a water gun on some unsuspecting victim. 4—George E. Rasor (C. P. Hall) happy over his prize. 5—T. T. Thompson (Sun Rubber), who turned in high gross with a snappy 165, gets a consolation prize from Jack Waite (Dugan & Campbell) while Ray S. Taylor (Firestone) approves. 6—Ward Sigler (Akron Standard Mold) and Ray S. Taylor in consultation. 7—Allyn I. Brandt (Philadelphia Rubber) and C. F. Marshall (Marshall Co.) giving good advice to the golfers on the 18th green. 8—Jack B. Waite proudly showing the club with which he chipped his first ball into the barrel. 9—E. J. Siess (Goodrich) arrives with his omnipresent pipe. 10—Del Schade, a victim of the old "Shell" game, and happy about it. 11—W. E. Tann and Ray S. Taylor, both of Firestone. 12—R. A. Atwood (Xylos Rubber), winner of the longest drive on the 17th. 13—Allyn K. Thayer (C. K. Williams), winner of a pair of shoes. 14—H. J. Karch (Martin Tire) won something. 15—J. F. Beal (Denman Tire), winner of low gross. All photographs and captions by Allyn K. Thayer. Mr. Thayer's photo was taken by Jack Von der Heide.

WORK STARTED ON BATA SHOE FACTORY

After many months of conflicting rumors, ground was broken on June 19 at Belcamp, Maryland, near Aberdeen, for the first unit of the large factory to be established by the Bata Shoe Co., Inc. The Price Construction Company, of Baltimore, was awarded the building contract on the initial unit. Additional contracts for the completion of other buildings are expected to be let soon.

The first unit of the new shoe factory, where rubber-canvas footwear will be made among other types, will be a factory building 350 x 80 feet, and will be five stories in height, comprising approximately 100,000 square feet of floor space. According to present estimates, this first unit will be completed sometime in September. Bata owns some 2,000 acres of ground at Belcamp.

Arrangements are said to have been made with the Department of Labor to permit at least 100 skilled workmen to enter the United States for one year from the home factory of Bata in Czecho-Slovakia. This factory is now located in German territory. These workmen will assist in setting up special machinery and in instructing American factory workers in operating it.

Bata will also soon start construction on a new factory in Canada at Frankford, Ontario. For some time it seemed doubtful whether the Ottawa Government would permit the company to bring in its own technicians, and Bata would not start construction activities unless such permission were granted.

Recently, however, the Ottawa Government was convinced that skilled technicians of the type required by Bata were not available in the Dominion and the necessary permission was granted. The company hopes to sell its Canadian output largely to Empire countries under the special tariff concessions provided within the British Empire.

TIRE CASINGS UP IN FIRST QUARTER

Tire casings in the hands of distributors as of April 1, 1939, amounted to 6,763,000 units, according to a quarterly survey conducted by the Leather and Rubber Division of the Bureau of Foreign & Domestic Commerce, Washington, D. C. This compares with 6,493,000 casings reported on hand on January 1, 1939. Tube inventories in the same comparison were 6,643,000 and 6,777,000, respectively. Inventories of 6,927,000 casings and 7,677,000 tubes were reported on April 1, 1938.

Total stocks of casings held were higher than stocks of tubes for the first time in the history of the quarterly surveys. The survey also indicated that there is a concentration to fewer sizes of casings, bringing about a reduction in the number of sizes that distributors are required to carry to meet the needs of tire consumers.

Coming Events

Sept. 11-13. Electrochemical Society, Hotel Commodore, New York City.

Sept. 13-15. Goodyear Centennial Celebration (in conjunction with 98th Meeting of the A.C.S.), Boston, Mass.

Oct. 15. 40th National Automobile Show, Grand Central Palace, N. Y.

Oct. 15-17. Nat'l Ass'n of Waste Material Dealers, Fall Convention, Baltimore, Md.

Oct. 16-20. National Safety Congress & Exposition, Atlantic City, N. J.

Dec. 4-9. 17th Exposition of Chemical Industries, Grand Central Palace, N. Y. C.

AKRON RUBBER GROUP HAS ANNUAL OUTING

The annual summer outing of the Akron Group, Rubber Division, A.C.S., was held at the Silver Lake Country Club in Akron on June 16. The day was ideal and more than 150 golfers teed off during the morning and afternoon. Golf was in order all day long, as is usual with this Group. Over 400 members and guests were present at dinner.

Lucky prizes and awards to winners of the various golf events were distributed after dinner. Golf prizes were awarded as follows: *Long Drive*—Bob Atwood (Xylos Rubber) and A. E. Lauchiskis (Goodyear); *Low Gross*—J. F. Beal (Denman) and W. H. Lewis, Jr. (Parr Paint); *Consolation High Gross*—T. T. Thompson (Sun Rubber).

Chairmen of the various committees for the day were: *Golf*—Ray S. Taylor (Firestone); *Prizes*—R. E. Cartledge (Midwest); *Tickets*—H. V. Powers (Goodyear); *Photography*—Jack von der Heide; *Publicity*—Ferd Bonstedt (Binney & Smith); *Horse-Play*—Walter Voth (Akron Standard Mold); *Refreshments*—Ferd Bonstedt; *Prize Solicitation*—H. V. Powers. J. B. Waite (Dugan & Campbell) acted as general chairman. A full page of "shots" taken at the outing by Allyn K. Thayer, of C. K. Williams & Co., will be found on the opposite page.

Appoint Sales Agent

The Alfa Machine Company has appointed the Spadone Machine Co., Inc., 122 East 25th St., New York City, as sales agents for its line of automatic and hand cutting machines and hand trimmers. These machines, designed for use in the rubber, paper, textile and other industries, feature a new type of self-adjusting clamp and self-honing knife.

AYRES IS OPTIMISTIC ON THE TIRE OUTLOOK

The tire industry is having a relatively good year in its sales of replacement tires and a better one than last year in its sales for original equipment, according to Col. Leonard P. Ayres, vice-president of the Cleveland Trust Co., in that institution's latest bulletin. "Probably its sales of replacement tires will constitute not far from three-quarters of all its sales in 1939," the bulletin states.

Discussing the trend of replacement tires sales, the bulletin goes on to state "sales of replacement tires were not far from twice as high in 1928 as they were in 1935 and 1936 despite the fact that the number of cars was increasing during almost all of that period. The reason is that the tires have been greatly improved in quality so that in recent years their mileage has been much increased. That change has been under way for a long time and the tire makers report that in 1915 each car in use wore out about eight tires per year as contrasted with an annual consumption now of only about one tire per car per year."

The records indicate, said Col. Ayres, that some 58 per cent of the buyers of new cars now operate their automobiles for three years before trading them in for new ones, and that nearly all of them make that trade-in while the original set of tires is still in use.

The average new car, according to the bulletin, is driven about 12,000 miles in its first full year of use, and it covers progressively smaller mileages each year until the cars that are about six years old or more average about 2,500 miles annually. Those cars, it was explained, are largely owned in the country and driven by farmers.

GOODYEAR ANNOUNCES NEW SHEET MATERIAL

Under the name of "Spectrafilm," a new, improved, stabilized rubber hydrochloride sheet material has been announced by the Goodyear Tire & Rubber Co., Akron. The material, which has a large percentage of rubber, is said to be ideally adaptable for use in bathroom and kitchen curtains, and to make excellent drapes for living rooms.

Spectrafilm has a rich gloss on both sides so that there is no "right" or "wrong" side, common to most materials. It is waterproof and may be cleaned with a damp cloth or sponge. Other advantages include its resistance to the action of sunlight, its imperviousness to water, and the fact that it is more flame resistant than other curtain materials.

The new sheet material is available in a variety of colors, including red, peach, dusty rose, nile green, transparent silver and gold, blue, corn and clear. The colors are all milky-transparent. Based on test results in a few selected cities, Goodyear will make formal announcement of Spectrafilm to the trade just as soon as the Pliofilm Sales Department completes distribution plans.

ADVERTISING PAGES REMOVED

FINANCIAL NEWS

$242,636 EARNED BY PHARIS TIRE COMPANY

A net profit of $242,636, after depreciation, expenses and Federal income taxes, for the seven months ended on May 31, has been reported by the Pharis Tire & Rubber Co., Newark, Ohio. This was equal to $1.10 each on the 220,000 shares of $1-par common stock. Since the company does not issue regular interim reports, no direct comparison with the previous year is available, but for the six months ended on June 30, 1938, the company reported a net profit of $224,116, or $1.02 per common share.

Gross sales for the period reported amounted to $4,700,154, an increase of $1,065,837, or 29%, over the same period of the previous year, according to a statement by Carl Pharis, president, accompanying the report. Current assets as of May 31 amounted to $1,988,867, including $337,030 in cash, as compared with current liabilities of $800,258. On June 30, 1938, current assets amounted to $1,690,874, including $315,391 in cash, and current liabilities to $667,080.

In his statement, Mr. Pharis said that the Pharis plant has been operating at full capacity, twenty-four hours a day, six days a week, throughout the major portion of the year. "Our present forecast is favorable for the balance of the year," he added.

GENERAL TIRE NETS TOTAL OF $1,103,575

For the six month period ended May 31, General Tire & Rubber Co., Akron, and subsidiaries, report a net profit of $1,103,575, equivalent to $1.96 per common share. For the corresponding period of the previous fiscal year, the company reported a net profit of $108,153.

Net sales, after deducting discounts, returns and allowances, and excise taxes, amounted to $10,917,345, an increase of 31.2% over the same period in 1938 when net sales totalled $8,322,039. Cost of goods sold, plus selling, general and administrative expenses, amounted to $9,435,499.

The consolidated statement shows deductions of $223,721 for depreciation, $17,211 for interest on borrowed money, etc., $8,583 for dividends on preferred stock of Aldora Mills, and provision of $280,000 for Federal income tax.

Spalding Plan Approved

Stockholders of A. G. Spalding & Bros. voted approval of a plan of recapitalization embodied in an agreement submitted to them at a special meeting held on June 22. Under the terms of the agreement, a newly formed Delaware corporation will absorb the present New Jersey corporation, of which Charles F. Robbins is president. The change will enable Spalding to pay dividends out of current earnings before the deficit accumulated up to October, 1938, is balanced, a proceeding which is not permitted under the laws of New Jersey. Full details of the recapitalization plan, approved by the stockholders on June 22, were given in the June, 1939, issue of THE RUBBER AGE.

Firestone Tire & Rubber

Six Months Ended April 30: Net profit of $2,851,538, after deducting depreciation, interest and Federal taxes, and after providing for dividends on the 6% cumulative preferred stock, Series A, which is equivalent to 75 cents a share on 1,936,458 shares of common stock outstanding. This compares with a net profit of $2,429,738, or 53 cents a share on 1,941,303 shares of common stock, in the corresponding period of the previous fiscal year.

Anticipate Note Payment

According to an announcement made by the directors of the Goodyear Tire & Rubber Company at a meeting held in Akron on June 26, the company has anticipated payment of $2,000,000 of serial notes issued last December in connection with its refunding program. Of the $2,000,000 paid off, $1,500,000 was due December 29, 1939, and the balance was due in 1943.

New General Atlas Plant

The General Atlas Carbon Company, New York City, producers of "Gastex" and "Pelletex" blacks, has announced the construction of a new plant at Guymon, Oklahoma. The site of the plant is actually one and one-half miles east of Guymon which is in the Panhandle section of Oklahoma, approximately 110 miles northwest of Pampa, Texas, the location of General Atlas' other plant. The new plant consists of 42 acres and is situated on a railroad main line. Construction work on the first two units, each of which will produce 10,000 pounds of black daily, has already been started and the plant is expected to be in operation by next September. General Atlas is celebrating its tenth anniversary this year.

Open Rumanian Factory

The Banloc Goodrich tire factory at Floresti, Rumania, fifty miles from Bucharest, was opened by the Rumanian Minister of Industry and Commerce last month. This factory, the first to make tires in Rumania, cost approximately $150,000, and will provide about three-quarters of the country's requirements. Apart from a few American experts, the factory is staffed by Rumanians.

NEW A.S.T.M. GROUP HAS INITIAL MEETING

The first meeting of the recently organized Technical Committee A on Automotive Rubber, a new group which will function under Committee D-11 on Rubber Products of the American Society for Testing Materials, was held in Detroit on June 8. A large number of technologists concerned with this special field of endeavor was present. L. A. Danse, metallurgist, Cadillac Motor Car Division, General Motors Corp., was elected chairman of the Committee, and J. D. Morron, manager, Motor Products Division, U. S. Rubber Co., was named secretary.

A. G. Herreshoff, chief research engineer, Chrysler Corporation, gave a talk outlining the purpose of the meeting and emphasizing the importance of the work. There was considerable discussion after which it was decided to confine the activities of the committee for the present to rubber used in motor mountings, and a section consisting of Messrs. Kimmich, Allen, Morron, Flower, and McCortney was appointed by the Chairman to obtain from the various rubber companies and correlate data on the physical properties of rubber compounds now being supplied to the automotive industry to meet the various motor mounting specifications. It was the thought of the meeting that by analyzing this data some degree of standardization may already be in effect or, if not, the information may point the way toward desirable standardization.

Another section was authorized to investigate test methods at present incorporated in motor mounting specifications so that the Committee may be informed as to significant differences used by various companies in evaluating the same property. This should help to give some idea of the worth of the physical data accumulated by the first section.

Need for prompt action was emphasized and it was indicated that the sections were expected to report not later than some time in July when another meeting would be held. Prominent technical authorities from various consuming and general interest groups as well as a number of rubber technologists and scientists will make up the technical committee. The Society of Automotive Engineers is officially represented.

Hold Colloid Symposium

The Sixteenth Colloid Symposium was held on July 6 to 8 at Stanford University, Palo Alto, California. Twenty-eight papers were scheduled for presentation at the Symposium, held under the sponsorship of the Division of Colloid Chemistry, A.C.S. Papers of special interest to the rubber industry included: "Molecular Weight of Sol and Gel in Crude Hevea Rubber," by A. R. Kemp and H. Peters; "Elasticity of Natural and Synthetic Rubber as Statistical Effect," by H. Mark; and "Behavior of Colloidal Suspensions with Electrolytes," by E. A. Hauser and Sidney Hirshem.

Names in the News

V. L. SMITHERS, head of the V. L. Smithers Laboratories, of Akron, Ohio, was recently appointed Commissioner of the National Battery Manufacturers Association, Inc., succeeding W. J. PARKER, resigned. His headquarters will be in the First Central Tower, Akron.

HENRY S. MARLOR, formerly assistant general manager, footwear division, U. S. Rubber Co., has been named general manager, succeeding T. J. NEEDHAM, who is a vice-president of the company, to that post. MR. NEEDHAM, however, will continue to supervise the department.

J. J. ALLEN, chief chemist, mechanical goods division, Firestone Tire & Rubber Co., Akron, was elected a member of the Executive Committee of the American Society for Testing Materials for a two-year term at the 42nd annual meeting of the Society held in Atlantic City the week of June 26.

F. L. JONES, secretary-treasurer, Quaker City Rubber Co., Philadelphia, Penna., one of the oldest members of that organization, celebrated his silver wedding anniversary last month.

I. T. DARLINGTON, who has served in various capacities with leading manufacturers of industrial coatings for the past eighteen years, has joined the research and development staff of the Stanley Chemical Co., East Berlin, Conn. He will also devote some time to sales service work.

GEORGE L. DIRKS, for many years manager of time study and standards in the engineering division, has been appointed master mechanic of the Akron plants of the B. F. Goodrich Co. He will report to H. E. COOK, superintendent of the engineering division.

GARRETT V. WESTON has been appointed sales promotion manager of the general products division of the U. S. Rubber Company, succeeding W. L. WARDELL who has been named assistant sales manager of that division. JOHN W. SPROUL, assistant sales manager of the company's golf ball department for the past ten years, has been advanced to the sales managership of that department.

GEORGE OENSLAGER, dean of the rubber industry's research chemists, and associated with the B. F. Goodrich Co. for many years, received an honorary degree of doctor of science at the annual commencement exercises of the University of Akron held on June 22. Honorary degrees of doctor of laws were bestowed on FRANK A. and CHARLES SEIBERLING at the same exercises.

GEORGE SCHAEFER has been appointed manager of the rolling mill machinery sales division of the Farrel-Birmingham Co., Inc., Ansonia, Conn., succeeding NORMAN SHAW who has been made manager of the company's Chicago office. HARRY TEMPORAL, who has been managing the Chicago office, has been transferred to the Buffalo division, while EDWARD S. COE, who has also been connected with the Chicago office, has been transferred to the rolling mill machine sales division in Ansonia.

R. F. DUNBROOK, research chemist, Firestone Tire & Rubber Co., was elected chairman of the Akron Section of the American Chemical Society at the Section's final meeting of the season held at the Congress Lake Country Club on June 2. He has been acting as vice-chairman for the past season.

MORRIS E. LEEDS, founder and president of the Leeds & Northrup Co., Philadelphia, Penna., assumed the position of chairman of the board, and CHARLES S. REDDING, vice-president in charge of research and engineering, became president, in a change of the company's executive set-up effective July 10.

E. W. R. STEACIE, of McGill University, has been appointed director of the Division of Chemistry of the National Research Council of Canada, Ottawa. For the past ten years he has been teaching and engaging in research activities.

H. E. VAN PETTEN, advertising manager, mechanical division, B. F. Goodrich Co., Akron, and FRED PINKERTON, sales promotion manager, mechanical goods division, U. S. Rubber Co., New York City, will be among those heading eleven industrial advertising clinics which will be conducted at the 1939 Conference of the National Industrial Advertisers Association, to be held at the Hotel New Yorker in New York City from September 20 to 22.

SIDNEY W. WINSLOW, JR., president, United Shoe Machinery Corp., Boston, Mass., was promoted to chairmanship of the board, ALBERT W. TODD, a vice-president was named president, and HAROLD G. DONHAM, also a vice-president, was named executive vice-president, at the quarterly meeting of the company held last month.

F. W. BIERWIRTH, vice-president of the Western Electric Co., and Manager of the company's works at Kearny, N. J., will become general manager of the distributing organization on September 1st. HENRY C. BEAL, manager of the apparatus and cable division at Kearny, will become manager of the Kearny Works.

Freight Rates Reduced

As a result of hearings before the Interstate Commerce Commission in the complaint filed by the National Gas Producers Association against the Akron, Canton and Youngstown Railway Co., et al, freight rates on carloads of compressed carbon black to certain destinations, including Akron, Boston, Chicago, New York and Milwaukee, will be reduced as of September 7, 1939. The Association complained that the rates on shipment of both compressed and uncompressed carbon black, which were raised last March, were unreasonable. The Commission held, however, that rates on uncompressed black were not and are not unreasonable, but that those on the compressed form would be unreasonable in the future. Rubber manufacturers will benefit from the reductions.

Herbert Standring Fund

An appeal has been issued by the rubber manufacturing industry of England for a benevolent fund being raised for Herbert Standring. Mr. Standring, now 78 years of age, founded the *India Rubber Journal*, England's leading weekly rubber journal, in 1884, and was one of the founders of the Institution of the Rubber Industry. In recent years, Mr. Standring has met with financial reverses and is now practically destitute. A responsible committee will be appointed to administer the fund. Checks should be made out to the "Herbert Standring Fund" and sent to W. F. V. Cox, c/o Institution of the Rubber Industry, 12 Whitehall, London, S.W. 1, England.

Newhall Leaves Goodrich

Arthur B. Newhall, executive vice-president of the B. F. Goodrich Co., Akron, and president of its subsidiary, the Hood Rubber Co., Watertown, Mass., resigned from the Goodrich organization on July 1 to assume new duties as vice-president of Talon, Inc., slide fastening manufacturers of Meadville, Penna. Mr. Newhall, whose resignation came as a complete surprise, had been associated with Hood Rubber for more than 20 years. Goodrich brought him to Akron last December, as executive vice-president of the parent concern. It was intimated that his position would not be filled immediately.

CLINTON DOEDE, for many years head of the physical chemistry division of the Firestone research laboratories at Akron, has resigned that post to join the Connecticut Hard Rubber Co., New Haven, Conn., as chief chemist.

RICHARD P. BROWN, formerly president and now chairman of the board of the Brown Instrument Co., was recently appointed as the first Secretary of the new Department of Commerce of the Commonwealth of Pennsylvania.

Los Angeles News

The Latex Seamless Rubber Co., a new concern which entered the rubber manufacturing field in Los Angeles a few months ago, now located at 2248 East 37th Street, will shortly move into a new building being erected for it at the intersection of East Washington and Connor Streets. The new building, one story and modern in design, will have 5,000 square feet of floor space and will be of stucco construction. The move will be made about August 15. Latex Seamless Rubber, which is licensed by American Anode, Inc., to make all types of latex dipped goods, is headed by Carl E. Stentz. Mr. Stentz recently returned from the East where he purchased additional equipment for the new plant.

Several changes have been made at the plant of the Arrowhead Rubber Company in Huntington Park. The offices have been moved up to the second floor and greatly enlarged. Another mill, a tubing machine, and other new equipment has been installed. Ray Cowles is superintendent of Arrowhead Rubber, which is also headed by Carl E. Stentz.

Victor Vodra, formerly with the chemical department of the Goodyear Tire & Rubber Company, has joined the staff of the Sierra Rubber Company, 2274 East 8th Street.

Work has begun on a one-story addition to the warehouse of the U. S. Rubber Company's plant. The addition, providing 54,000 square feet, will be used for the storage of finished products. An addition for the storage of raw materials was completed several weeks ago. Both additions are of brick construction reinforced with concrete framing.

Charles Cook, former popular member of Goodyear's sales organization in California, died recently in the California Hospital following a five-week illness. He had been in the state for 25 years and had served as general line salesman, assistant manager of the Los Angeles district, and special representative in charge of truck and farm implement tires. He is survived by his widow and one daughter.

Joseph Dunlap, development department, Goodyear Tire & Rubber Co., Akron, visited the Los Angeles plant last month while en route to India where he will relieve C. H. Wyles as factory technical representative. Mr. Dunlap also expected to visit Goodyear's plant in Australia.

The name of the Samson Tire & Rubber Corporation was formally dropped as of July 1st and the factory operated by that organization will henceforth be known as the Los Angeles Plant of the U. S. Rubber Company.

The Goodrich plant is well on its way toward another long term safety record. A slight accident in January broke a continuous no-lost-time record of 489 days. On July 10 the record for the new stretch reached its 187th day. In other words, in almost two full years only one injury has occurred which resulted in an employee losing working time at the plant.

M. O. Simpson, control manager of the U. S. Rubber plant, has been transferred to Montreal where he will act as controller for the Dominion Rubber Co., Ltd., the company's Canadian subsidiary. C. M. Spinning, formerly connected with the company's fabric mills at Hogansville, Georgia, has taken Mr. Simpson's place.

New Black Rock Agency

The Black Rock Manufacturing Co., Bridgeport, Conn., has just appointed the Lombard Smith Co., 2032 Santa Fe Avenue, Los Angeles, Calif., as its representative on the Pacific Coast. The Smith concern will cover the states of Washington, Oregon and California. Headed by Lombard Smith, the company is in close touch with rubber manufacturers on the Coast and the appointment is expected to result in better service for Black Rock customers located in the three states.

Fire at Pollack Bros. Plant

A fire of unknown origin, which started in a heap of scrap tires stored in the yard, practically wiped out the one-story brick building maintained by the Pollack Bros. Scrap Rubber Corporation at 228 Newport St., Brooklyn, N. Y., on June 29. Considerable damage to stock was reported. Forty firemen were overcome by smoke fumes from the burning rubber before the stubborn fire was brought under control.

New England News

Lightning which struck a high tension wire is blamed for a fire which swept the plant of the Quabaug Rubber Co., North Brookfield, Mass., on June 17, causing damage estimated at $100,000. The central building, housing machinery and motors, was destroyed, and the west wing, used for storage purposes, badly damaged. Firemen saved the plant's east wing. Herbert T. Mason, general manager, said reconstruction would begin immediately. The plant employed 350 men and produced a variety of rubber goods including floor coverings, rubber heels, and stair treads.

Wilson H. C. Smith, a pioneer in the sale of General Electric wires and cables, and for many years manager of G-E rubber insulated wire and cable sales at Bridgeport, Conn., retired July 1 after nearly 40 years of service. At the time of his retirement, he was assistant to J. H. Crawford, manager of the Construction Material Sales Division of the G-E Appliance and Merchandise Department. When Mr. Smith joined General Electric at Schenectady in 1900, paper and other forms of insulation were in general use, as rubber then cost about $1.30 per pound.

L. C. Lovejoy, personnel manager of the Fisk Rubber Corp., Chicopee Falls, Mass., has been elected president of the Springfield (Mass.) Chapter of the National Office Managers Association.

More employees of the United States Rubber Co., Naugatuck, Conn., than ever before received vacation pay for the annual layoff period starting July 1, according to Walter H. Norton, factory manager. The vacation pay policy, Mr. Norton said, has been broadened so that employees this year received 2 per cent of their earnings, "whether they happened to be working or not, provided they had worked with the company for a year, and for at least 13 weeks since June, 1938". The total vacation pay disbursement amounted to $93,000.

The usual summer schedule of outings and excursions for U. S. Rubber employees is under way. On June 26 the purchasing, payroll and tabulating departments held an outing at Lake Quassapaug, Middlebury; the mechanical department will have an outing July 22 at Nettleton's Grove, Beacon Falls; the waterproof department affair is planned for August 5 at Schildgen's Grove, Naugatuck; and on August 26 employees of the tennis stitching departments will make an excursion to the New York World's Fair.

On July 1, pensioners of the Naugatuck Chemical Division were honored by the management at a dinner at Sullivan's Inn and later at the outing of the Alembic Club at Lake Quassapaug.

A new definition of employment as applied to the Connecticut unemployment compensation law became effective July 1. Under the terms of amendments made by the 1939 legislature, the definition is broadened so that some employment outside of this state will now be covered by the provisions of the law. The test is whether the employment outside the state is incidental to employment within Connecticut or whether the base of operations or place of control of the work is in Connecticut.

TIRE MANUFACTURERS WARNED ABOUT "ADS"

Climaxing the nearest approach to a price war on passenger car tires experienced in the industry in more than three years, warnings against misleading and deceptive tire advertising claims were issued early this month by Better Business Bureaus in several leading cities, civil action against price cutters in two cities by local dealer groups, and appeals to the Federal Trade Commission by the National Association of Independent Tire Dealers.

All of the complaints were principally against advertisements which featured offers of "50% savings" which in many cases proved to be a percentage compared to former tire prices no longer in effect. Several of the Better Business Bureaus lodged complaints directly with the tire companies involved.

In Atlanta, Georgia, four tire dealers obtained temporary restraining orders against Goodyear and Firestone in suits which asked damages of $5,000 for each dealer and a permanent injunction against advertisements offering "50% savings." Hearings in the suits were expected to be held soon. Dealers in Savannah are also understood to have filed similar suits.

George J. Burger, general manager of the N.A.I.T.D., declared that many of the advertisements carried fictitious list prices, higher than the actual list prices, and that the sale prices were claimed to be sharp reductions from the spurious quotations. He reported that his office had been flooded with complaints from dealers and that he had appealed in the name of the Association to the Federal Trade Commission to put an end to what he termed "deceptive advertising." No comment on the situation has been made by the tire manufacturers.

1938 INJURY RATE IN RUBBER INDUSTRY

The 1938 injury experience of the rubber industry, based on reports covering 38 plants, 51,023 employees, and an exposure of 85,388,000 man-hours, was recently revealed by the Rubber Safety Section of the National Safety Council. The frequency rate of 6.92 was 43% below the average for all industries and the severity rate of 0.58 was 62% less than the general average. Standings of the industry in comparison with 30 other major industries were fifth in frequency and third in severity.

Rubber factories have more than kept pace with other industries in reducing injury rates, according to the report. The improvement in frequency of 72% exceeded the average reduction by all industries. In severity, the reduction of 58% since 1936 compares with an average of 44% for all industries.

All types of injuries decreased in frequency and severity from 1937 to 1938 with the exception of the severity of temporary disabilities. The frequency of fatalities dropped sharply and this largely accounted for the marked improvement in the industry's severity rate.

Since 1926, all types of injuries have decreased in frequency and severity. Improvement in experience with serious injuries has kept up with lower rates for temporary total disabilities which has not been the case in many other industries.

Tire Machinery Sold

All of the rubber machinery and equipment used by the former National Tire & Rubber Company in the plant it maintained at East Palestine, Ohio, was recently sold to an undisclosed purchaser. The negotiations were conducted for the sellers, R. B. Taggart of East Palestine, and Margaret E. Stewart of Aberdeen, Wash., by Attorney L. M. Kyes of East Palestine. The large, two-story, concrete, brick and steel plant will now be disposed of for other industrial purposes.

New "Seal-O-Matic" Tube

A new type of "Seal-O-Matic" tube, which is said to seal punctures automatically and to convert blow-outs into slow leaks, has been announced by the B. F. Goodrich Co., Akron. Engineers are reported to have imitated the three-ply structure of a tree trunk in designing the new tube. A special heavy compound of rubber which cannot be pinched, thus eliminating one cause of blow-outs, corresponds to a tree's bark. Like the fibrovascular bundles of a tree, the second layer is softer and acts as a binder between the outer and third, or inner, layer, which is a gummy compound similar to the cambium layer of a tree. This inner layer is a soft sheath which "grows" around any puncturing object. When a nail, rock, or piece of glass is withdrawn from the tube, the gummy inner layer is pulled out through the aperture with the puncturing object and then hardens, sealing the opening automatically.

CAVALCADE OF TREADS MARKS GOODRICH DAY

The entrance of the B. F. Goodrich Company into its 70th year of corporate existence was celebrated with a double-barreled observance on July 1st—"Goodrich Day" at the New York World's Fair and the annual outing of the company held in Akron.

The contributions made by Goodrich to American transport safety in its seventy years of existence were dramatically depicted in a historical tableau at the Goodrich exhibit at the World's Fair. Hostesses of the exhibit, garbed in motoring outfits dating from 1890, took part in the tableau. Six girls showed treads representing the first solid "horseless carriage" tire, the first pneumatic, the first cord, and other "firsts." The treads of these epoch-making tires were also imprinted in a concrete slab in front of the grandstand in the Goodrich arena at the Fair. Part of the tableau is indicated in the illustration above. Arthur B. Newhall, executive vice-president of Goodrich, since resigned, outlined the colorful history of Goodrich's seven decades at the Fair ceremonies, during which service pins were given to several employees.

At Akron, more than 5,000 employees, including a majority of 20-Year Club members, heard S. B. Robertson, president, and other company officials. Later in the day, several internationally known traffic authorities stressed the contributions of industry to highway safety in a series of radio broadcasts sponsored by Goodrich.

Obituaries

Julius Schmid, Sr.

Julius Schmid, Sr., founder of Julius Schmid, Inc., one of the largest manufacturers of prophylactics in the United States, died at the age of 74 at his home in Beverly Hills, Calif., on June 6. He had retired from active participation in the management of the company he founded, which has headquarters in New York City, and a factory in Little Falls, N. J., several years ago, turning the management over to his sons, Carl and Julius Schmid, Jr.

Handicapped by infantile paralysis since the age of 3, Mr. Schmid, a native of Germany, arrived in the United States when 17 years of age. It was while working in a drug store in New York City that his interest is said to have been first aroused over the composition of a skin cover on perfume and other toiletries bottles. At that time—in 1883—most of these skins were imported from France.

Mr. Schmid's interest soon resulted in the development of a process for the manufacture domestically of similar skins and the firm of Julius Schmid, Inc., was born. From the perfection of the manufacture of these skins for the perfumery trade came the production of successful rubber prophylactics. His accomplishment in rearing the modern prophylactic industry is best understood when it is realized that his entire first year's output was less than one-fourth of the daily production of prophylactics in this country today.

Mr. Schmid's pride in his business achievement was exceeded only by the ownership and development of what is generally acknowledged to be the finest herd of Holstein cattle in the world. His Beaver Dam Stock Farm, in Montgomery, N. Y., where he made his home for many years, is world-famous. Its sole output is certified milk. At one time, however, stock from the herd was sold to leading breeders in all parts of the globe.

Harry A. Larson

Harry A. Larson, technical superintendent of the Electric Hose & Rubber Co., Wilmington, Del., collapsed on the golf course of the Wilmington Country Club on June 16 and died before he reached a hospital. Mr. Larson, who was 51 years of age, was entered in a golf tournament and was playing in the qualifying round when he collapsed.

A Canadian by birth, Mr. Larson was associated with the Mechanical Rubber Company of Cleveland, Ohio, before he joined the Electric Hose & Rubber Company as a chemist in 1917. He was made assistant superintendent of Electric Hose in 1925 and appointed technical superintendent in 1929. He is believed to have attended McMaster's University in Canada and also to have taken a special course at the Massachusetts Institute of Technology.

Mr. Larson spent much of his early life in Western Canada. He was an ex-service man, having served with the American Army during the World War. For the past five years he had been living in Newark, Delaware, He leaves a widow, son and daughter.

Morton F. Judd

Morton F. Judd, secretary and general manager of Raybestos-Manhattan, Inc., Stratford and Bridgeport, Conn., and long active in Connecticut industry, died at his home in Stratford on June 28 at the age of 53 after an illness of several months. A graduate of the Yale School of Fine Arts, Mr. Judd served the Bullard Co., Bridgeport, and the American Optical Co., Southbridge, Mass., before joining the Raybestos Company in 1916 as assistant sales manager. He rose to vice-president of the company and executive assistant to Sumner Simpson, president, and after the consolidation which resulted in the present firm of Raybestos-Manhattan, Inc., he remained as secretary and general manager. He leaves a widow and one son.

Harry Symington

Harry Symington, senior partner of Symington & Wilson, Plantation House, London, E.C. 2, England, one of the leading rubber brokerage houses of England, died recently at the age of 63. An authority in the rubber market, Mr. Symington took a prominent part in the formation in 1913 of the Rubber Trade Association of London, which controls the Rubber Exchange, and was the first vice-chairman of that group. He also served as chairman of the Association in 1925 and 1932.

Conrad S. Weeks

Conrad S. Weeks, secretary-treasurer and general manager of the Canton Rubber Co., Canton, Ohio, which was founded by his father, George W. Weeks, died from a heart ailment while playing tennis in Canton on June 3. He was 44 years of age and had apparently been in good health. Funeral services were held on June 7 with interment in Westlawn Cemetery, Canton. He leaves a widow and one daughter.

Dallas D. Burress

Dallas D. Burress, chief chemist of the Ball Bros. Co., Muncie, Indiana, died suddenly recently at the age of 31. He had been associated with the company for more than twelve years and was highly regarded in the industry. Mr. Burress was a director of the Indiana Chemical Society.

Ralph W. Grant

Ralph W. Grant, plant manager of the Clifton, N. J., Division of the National Rubber Machinery Co., died on June 27, at the age of 45. Born in Pawtucket, R. I., Mr. Grant received his early education in the city's public schools and then attended Brown University. After being graduated, he joined the Brown & Sharpe Mfg. Co., leaving that company two years later to accept a position with the Splitdorf Electrical Co. in Newark, N. J. In 1919 Mr. Grant went with DeMattia Bros., Inc., as chief draftsman, a position he held until 1927. When DeMattia Bros. was merged into the National Rubber Machinery Co. he was made a sales engineer. In 1935, when National Rubber was reorganized, Mr. Grant was made plant manager of the Clifton Division, a post he held until his death. Mr. Grant, who was an active Mason, was well known as a taxidermist and as a clarinet player.

EDITOR'S NOTE: As this issue was going to press notice was received of the deaths of John V. Mowe, head of the Twemo Corporation, and of Mrs. Cyrus S. Ching, wife of the director of industrial relations for the United States Rubber Company. Mr. Mowe died on July 8 at North Hero, Vermont, while Mrs. Ching, who had been ill for many months, passed away at her home in Jackson Heights, N. Y. Obituaries on both will appear in more detail in our next issue.

Union Shop Agreement

The first union shop agreement obtained by the United Rubber Workers of America in the rubber industry was announced last month by Sherman H. Dalrymple, president of the union which is affiliated with the C.I.O. The contract is with the Denman Tire & Rubber Co., of Warren, Ohio, and provides for plant-wide seniority and vacations with pay. Under the terms of the agreement, all new employees hired by Denman shall become members of the union within two months after the beginning of employment. It was also revealed that contracts providing for the check-off of union dues have been signed with the Bloomingdale Rubber Co., of Chester, Penna.

Renews National Advertising

After an absence of many years, the Pennsylvania Rubber Co., Jeannette, Penna., is back in the national advertising picture with a campaign on its RX tires. Several leading publications are being used in the campaign which features "Super-Press Curing," said to be a "brand new process which builds a new kind of tire." Operations of the company are reported to have been on a very satisfactory plane during the first half of the current year. Sales of tennis balls and playballs, in which Pennsylvania enjoys a leading position, have especially maintained a high level.

MARKETS

RUBBER—COTTON AND FABRICS—CHEMICALS

NEW YORK, JULY 11, 1939

Crude Rubber

OPENING with a quotation of 16.40 for spot on the Commodity Exchange on July 12, crude rubber prices started a declining movement attributed to an exceptionally dull market and touched 16.22 on June 15, low for the period. Even release of domestic consumption figures for May, which were higher than April, failed to halt the decline. An upward trend began on June 19, abetted by better cables from abroad, renewed factory interest and commission house buying, the price rising to 16.43 on June 26, the highest level reached in the period. From June 27 to today (July 11) the price has moved erratically in a 10 point range, disturbing news from Europe sending it down a few points one day and encouraging reports from London and Singapore, combined with domestic buying waves, bringing it up again another day. The futures market, however, held fairly steady throughout the period. The undertone in physicals has seemed to be a bit firmer in the past several days than it was earlier in the period. Quotations in the outside market, Exchange, London and Singapore, follow:

As of July 11

Plantations—

Ribbed Smoked Sheets—			
No. 1 Spot	—	@	.16⅜
October-December	—	@	.16 5/16
January-March	—	@	.16⅝
No. 2	—	@	.16 7/16
No. 3	—	@	.16 5/16
No. 4	—	@	.16¼
Thin Latex Crepe	—	@	.18
Thick Latex Crepe	—	@	.18
Brown Crepe, No. 1	—	@	.15⅞
Brown Crepe, No. 2	—	@	.15¾
Amber Crepe, No. 2	—	@	.15⅞
Amber Crepe, No. 3	—	@	.15¾
Brown Crepe, Rolled	—	@	.15

Latex—

Normal, per lb., carload lots	—	@	.19¾

Paras—

Up-River, fine	—	@	.14¼
Acre Bolivian, fine	—	@	.14⅜

Balata—

Surinam sheet	—	@	.38

LONDON MARKET

Standard Smoked Sheets—Buyers—July 11			
October-December	8 5/16	@	8 3/16d
January-March	8⅜	@	8½d

SINGAPORE MARKET

Standard Smoked Sheets—Sellers—July 11			
October-December	—	@	7 15/16d
January-March	—	@	7 15/16d

Reclaimed Rubber

Although the second quarter of the current year was not as active as the first, reclaimers report fairly good business. July, especially, opened weak, but demand increased substantially in the past week or so. Still better demand is expected. There has been no change in the price structure since our last report. Current quotations follow:

Shoe

Unwashed	lb.	.06½	@	.06¾
Washed	lb.	.10	@	.10¼

Tube

No. 1 (Floating)	lb.	.12	@	.12¼
No. 2 (Compounded)	lb.	.08	@	.08¼
Red tube	lb.	.08	@	.08¼

Tires

Black (acid process)	lb.	.07	@	.07¼
Black, selected tires	lb.	.06	@	.06¼
Dark Gray	lb.	.09¼	@	.09¾
White	lb.	.11½	@	.12
Truck, Heavy Gravity	lb.	.05½	@	.06
Truck, Light Gravity	lb.	.07	@	.07½

Miscellaneous

Mechanical blends	lb.	.04½	@	.05

Scrap Rubber

(Delivered Akron Mills)

Demand for scrap rubber was good throughout June but has slackened off a little this month. Stocks have been somewhat depleted but are still sufficient for immediate demand. Dealers look for an active August. There has been no change in the price structure since our last report. Current quotations follow:

(Prices to Consumers)

Auto tire peelings	ton	18.50	@	19.50
Mixed auto	ton	12.50	@	13.00
Beadless tires	ton	14.50	@	15.50
Clean solid truck tires	ton	23.00	@	25.00
Boots and shoes	ton	18.50	@	19.50
Arctics, untrimmed	ton	13.00	@	15.00
Inner tubes, No. 1	lb.	.08	@	.09
Inner tubes, No. 2	lb.	.03¾	@	.04
Inner tubes, Red	lb.	.03⅜	@	.03¾

Cotton

Swinging in a 31 point range, the price for middling uplands on the Exchange passed the 10-cent mark again for the second time this year. Based upon the Government's acreage report of 24,943,000 acres, the smallest for harvest since 1899, the price jumped from 9.87 on July 8 to 10.02 on July 10, the following trading day. This was high for the period; low was 9.72 quoted on June 30. The market was kept in a state of uncertainty for the major portion of June due to conflicting reports on the Agricultural Bill. The chief concern was whether or not the Conference Committee would take definite action on the export subsidy and the parity payment proposals. Secretary Wallace's statement that the Administration had a "united front" in favor of export subsidies and that the Department of Agriculture was willing to compromise on funds for such a program served to strengthen the price, as did the announcement of the cotton-for-rubber agreement signed between the United States and the United Kingdom. Prices are expected to remain in the higher channels. Quotations for middling uplands on the Exchange follow:

	June 9	July 11		
	Close	High	Low	Close
July	9.29	9.65	9.58	9.63
October	8.45	9.03	8.92	8.98
December	8.20	8.88	8.76	8.82

(Prices Net at the Mill)

Tire Fabrics

Peeler, carded, 23/5/3	lb.	.28	@	—
Peeler, carded, 23/4/3	lb.	.29	@	—
Peeler, carded, 15/3/3	lb.	.26	@	—
Peeler, carded, 13/3/3	lb.	.25	@	—
Egyptian, carded, 23/5/3	lb.	.39¼	@	.39½
Egyptian, combed, 23/5/3	lb.	.44¼	@	.44½
CHAFERS				
Carded, American, 1 1/16"	lb.	.27½	@	.27¾
Carded, American, 1"	lb.	.17¾	@	.23½

Sheetings

48x40	36 in.	5.50	lb.	— @	.03⅞
40x40	36 in.	6.15	lb.	— @	.03½
40x36	36 in.	6.50	lb.	— @	.03⅜
48x48	40 in.	2.50	lb.	— @	.07½
48x48	40 in.	2.85	lb.	— @	.06½
56x60	40 in.	3.60	lb.	— @	.05¾
48x44	40 in.	3.75	lb.	— @	.05⅛
44x40	40 in.	5.50	lb.	— @	.04

Ducks

Enameling (single filling)	lb.	.21	@	.23
Belting and Hose	lb.	.25¼	@	—
Single filling, A grade	lb.	.09½	@	.12½
Double filling	lb.	.10½	@	.13¼

Closing Rubber Prices on New York Commodity Exchange, Inc.

No. 1 Standard Contract of 10 tons

FROM JUNE 10 TO JULY 11

Date		Spot	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Sales
June	10															
	11															
	12	16.40	16.31	16.34	16.39	16.44	16.45	16.46	16.47	16.48	16.49	16.51	16.52	16.53		64
	13	16.35	16.27	16.29	16.33	16.38	16.39	16.40	16.41	16.42	16.43	16.45	16.46	16.47		67
	14	16.25	16.15	16.17	16.21	16.26	16.28	16.30	16.31	16.33	16.34	16.35	16.36	16.37		100
	15	16.22	16.18	16.20	16.22	16.24	16.25	16.26	16.28	16.30	16.32	16.34	16.35	16.36		107
	16	16.22	16.15	16.17	16.20	16.24	16.26	16.27	16.29	16.30	16.31	16.33	16.34	16.35		49
	17															
	18															
	19	16.28	16.22	16.24	16.28	16.33	16.34	16.35	16.36	16.37	16.39	16.41	16.42	16.43		79
	20	16.37	16.31	16.33	16.37	16.42	16.43	16.44	16.46	16.47	16.48	16.49	16.50	16.51		116
	21	16.35	16.28	16.30	16.34	16.39	16.41	16.43	16.45	16.46	16.46	16.47	16.51	16.55		102
	22	16.32	16.25	16.27	16.31	16.35	16.37	16.39	16.41	16.43	16.45	16.46	16.48	16.50		147
	23	16.35	16.27	16.29	16.32	16.36	16.37	16.38	16.39	16.41	16.43	16.45	16.47	16.49		101
	24															
	25															
	26	16.43	16.34	16.35	16.40	16.45	16.45	16.46	16.47	16.49	16.51	16.53	16.55	16.57		225
	27	16.33	16.26	16.28	16.32	16.37	16.38	16.40	16.42	16.43	16.45	16.46	16.47	16.48		185
	28	16.35	——	16.30	16.34	16.38	16.40	16.42	16.45	16.47	16.48	16.49	16.50	16.51		284
	29	16.40	——	16.35	16.37	16.40	16.42	16.43	16.45	16.46	16.46	16.47	16.48	16.49		154
	30	16.43	——	16.36	16.35	16.35	16.35	16.35	16.35	16.38	16.39	16.40	16.41	16.42		173
July	1															
	2															
	3	16.37	——	16.30	16.30	16.31	16.33	16.35	16.38	16.39	16.40	16.41	16.42	16.43	16.44	17
	4															
	5	16.38	——	16.33	16.33	16.33	16.35	16.37	16.39	16.40	16.41	16.43	16.45	16.48	16.50	76
	6	16.43	——	16.35	16.36	16.38	16.40	16.41	16.43	16.45	16.46	16.48	16.49	16.50	16.51	155
	7	16.36	——	16.31	16.34	16.36	16.38	16.40	16.42	16.43	16.44	16.45	16.47	16.49	16.51	175
	8															
	9															
	10	16.37	——	16.30	16.32	16.35	16.37	16.38	16.40	16.42	16.43	16.45	16.45	16.46	16.47	100
	11	16.42	——	16.37	16.37	16.38	16.39	16.41	16.43	16.44	16.45	16.47	16.48	16.50	16.52	123

New York
July 12, 1939

Rubber CHEMICAL Markets

All Quotations F.O.B. Works Unless Noted

ACCELERATORS

Organic			
A-1 (Thiocarbanilid)	lb.	.24 @	—
A-10	lb.	— @	.36
A-11	lb.	.52 @	.65
A-19	lb.	.52 @	.65
A-32	lb.	.70 @	.80
A-77	lb.	.42 @	.55
A-100	lb.	.42 @	.55
Aldehyde ammonia, crystals	lb.	.65 @	.70
Altax	lb.	.55 @	.65
Butyl Zimate	lb.	2.50 @	—
Captax	lb.	.50 @	.60
Crylene	lb.	.55 @	.65
paste	lb.	.45 @	.55
Di-Ortho-Tolyguanidine	lb.	.44 @	.46
Diphenylguanidine	lb.	.35 @	.45
El-Sixty	lb.	.50 @	.65
Ethyl Zimate	lb.	2.50 @	—
Ethylidene aniline	lb.	.42 @	.43
Formaldehyde aniline	lb.	.37½ @	.42
Guantal	lb.	.40 @	.50
Heptene	lb.	.35 @	.40
Hexamethylenetetramine	lb.	.33 @	—
Lead Oleate, No. 999	lb.	.14 @	—
Witco		.15 @	—
Lithex	lb.	.18 @	.20
Methylenedianiline	lb.	.36 @	.37
Monex	lb.	— @	2.35
Oxynone	lb.	.64 @	.80
Phenex	lb.	.50 @	.55
Pip-Pip	lb.	2.50 @	—
Pipsolene	lb.	1.55 @	1.85
R & H 40	lb.	.40 @	.41
R & H 50-D	lb.	.42 @	.43
R-2	lb.	1.40 @	1.80
R-2 Crystals	lb.	2.50 @	2.75
R-23	lb.	.40 @	—
RN-2	lb.	1.40 @	1.80
RN-2 Crystals	lb.	2.00 @	2.25
Rotax	lb.	.60 @	.65
Safex	lb.	1.25 @	1.30
SPDX	lb.	.70 @	.75
Super-Sulphur No. 1	lb.	.50 @	—
No. 2	lb.	.18 @	.20
Thiocarbanilid, drums	lb.	.24 @	.30
Trimene	lb.	.55 @	.65
base	lb.	1.05 @	1.20
Triphenylguanidine	lb.	.45 @	—
Tuads	lb.	2.35 @	—
Ulto	lb.	1.50 @	1.75
Ureka	lb.	.60 @	.75
Ureka Blend B	lb.	.60 @	.75
Ureka C	lb.	.56 @	.65
Vulcanex	lb.	.42 @	.43
Vulcanol	lb.	.85 @	—
Zimate	lb.	2.35 @	—
Inorganic			
Litharge, domestic	lb.	.07 @	.07½
Magnesia, calcined, heavy	lb.	.04 @	—

COLORS

Blacks (See Compounding Materials)

Blues			
Prussian	lb.	.36 @	.37
Ultramarine	lb.	.15 @	—
Browns			
Mapico	lb.	.13 @	—
Umber, Turkey	lb	.04 @	.04½
Greens			
Chrome	lb.	.21 @	—
Chromium Oxide, bbl.	lb.	.21 @	—
Guignet's Green	lb.	.?0 @	—
Reds			
Antimony crimson, 15/17	lb.	.45 @	—
sulfur, free	lb.	.48 @	.60
Indian English	lb.	.09 @	.10
Domestic (Maroon)	lb.	.11 @	—
Red oxide, pure	lb.	.10 @	.12
Rub-Er-Red, f.o.b. Easton	lb.	.09¼ @	—
Whites			
Cryptone, No. 19	lb.	.05¼ @	.05½
Cryptone CB, No. 21	lb.	.05¼ @	.05½
Cryptone, ZS-230	lb.	.07½ @	.07¾
Cryptone, ZS-86	lb.	.07½ @	.07¾
Lithopone			
Albalith, black label—11	lb.	.03¾ @	.04
Azolith	lb.	.03¾ @	.04
Ray-bar	lb.	.05⅝ @	.06⅛
Ray-cal	lb.	.05⅝ @	.06⅛
Rayox	lb.	.14 @	.17
Titanox A	lb.	.13 @	.16
Titanox B	lb.	.05¼ @	.06½
Titanox C	lb.	.05¼ @	.06⅛
Zinc Oxide—American Process			
American Azo:			
ZZZ (lead free)	lb.	.06¼ @	.06½
Anaconda, lead free	lb.	.06¾ @	.06½
Horsehead Lead Free Brand:			
Special—3	lb.	.06¼ @	.06½
XX Red—4	lb.	.06¼ @	.06½
XX Red—72	lb.	.06¼ @	.06½
XX Red—78	lb.	.06¼ @	.06½
XX Red—103	lb.	.06¼ @	.06½
Kadox, black label—15	lb.	.06½ @	.06¾
Blue label—16	lb.	.06½ @	.06¾
Red label—17	lb.	.06½ @	.06¾
St. Joe, black label	lb.	.06¼ @	.06½
green label	lb.	.06¼ @	.06½
red label	lb.	.06¼ @	.06½
U. S. P—7. bbls.	lb.	.09½ @	.09¾
Zinc Oxide—French Process			
Florence White seal—7 bbls.	lb.	.08½ @	.08¾
Green seal—8	lb.	.08 @	.08¼
Red seal—9	lb.	.07½ @	.07¾
Yellows			
Cadmolith	lb.	.45 @	.50
Chrome	lb.	.14½ @	.15½
Mapico	lb.	.09½ @	—

BLACKS

Arrow "Aerfloted" Specification	lb.	.0275 @	.0625
Bone, powdered	lb.	.05½ @	.14
Carbon, compressed	lb.	.0275 @	.0625
uncompressed	lb.	.0275 @	.0625
"Certified"	lb.	— @	—
"Spherons"	lb.	— @	—
"Disperso"	lb.	.0275 @	.0625
"Excello," compressed	lb.	.0275 @	.0625
"Fumonex"	lb.	.03 @	.05
"Gastex"	lb.	.03 @	.05
Lampblack	lb.	.07 @	.12
"Micronex"	lb.	.0275 @	.0625
"Supreme"	lb.	.0275 @	.0625
Thermatomic—"P 33"	lb.	.04¾ @	.07¾
"Thermax"	lb.	.01¾ @	.05
United "Dixie" & "Kosmos"	lb.	.0275 @	.0625

COMPOUNDING MATERIALS

Aluminum Flake	ton.	21.85 @	24.50
Ammonia carbonate, lump	lb.	.10¼ @	.12
Asbestine	ton	13.00 @	15.00
Barium carbonate (98-100%)	ton	— @	—
Barium Dust	lb.	.05 @	.06
Barytes	ton	23.65 @	31.15
Basofor	lb.	.04½ @	—
Bentonite	lb.	.02 @	.03
Blanc fixe dry f.o.b. works	ton	60.00 @	65.00
Calcene	ton	37.50 @	45.00
Catalpo (fact.)	lb.	.02 @	—
Chalk, precipitated			
Suprex white, extra lt.	ton	45.40 @	60.00
heavy	ton	45.00 @	55.00
Clay, Kaolin, domestic	ton	7.50 @	15.00
Aerfloted, Suprex	ton	9.50 @	21.00
Congaree	ton	9.50 @	—
Crown (f.o.b. plant)	ton	9.50 @	—
Dixie	ton	11.00 @	26.00
Dixie, Jr.	ton	9.50 @	24.00
McNamee	ton	9.50 @	22.00
Par	ton	9.50 @	22.00
Witco	ton	9.50 @	—
Cotton Flock (Dark)	lb.	.10 @	.12
Glues, extra white	lb.	.28 @	.30
medium white	lb.	.14 @	19
Kalite No. 1	ton	24.00 @	50.00
Kalite No. 3	ton	34.00 @	60.00
"Lime Crest" Industrial Filler No. 100		— @	—
Magnesium carbonate	lb.	.07½ @	—
Mica	ton	35.00 @	44.00
Pyrax A	ton	6.00 @	20.00
Rottenstone (powdered)	lb.	.02½ @	.03
Soapstone, powdered	ton	16.00 @	22.00
Starch, powdered	cwt.	2.90 @	4.10
Talc, domestic	ton	17.00 @	20.00
Whiting, commercial	ton	17.00 @	18.00
Columbia Filler	ton	9.00 @	14.00
English Cliffstone	ton	33.00 @	43.00
Witco	ton	6.00 @	—
Wood Flour	ton	20.00 @	25.00
Zinc Carbonate	lb.	— @	.10¾
Zinc Stearate	lb.	.23 @	—

MINERAL RUBBER

285°-300° Mineral Rubber	ton	22.00 @	42.00
Black Diamond	ton	27.00 @	—
Genasco, solid (factory)	ton	25.00 @	27.00
Hard Hydrocarbon	ton	22.00 @	42.00
Parmr, solid	ton	25.00 @	—
Pioneer, MR, solid	ton		
Pioneer-granulated	ton		

MISCELLANEOUS

Aromatics—Rodo #0	lb.	3.50 @	4.00
Rodo #10	lb.	4.50 @	5.00
Curodex 19	lb.	2.75 @	—
Curodex 188	lb.	3.50 @	—
Curodex 198	lb.	4.50 @	—
Para-Dors No. 5145	lb.	2.00 @	—
Areaklene No. 375 (dispersing, wetting and penetrating agent)	lb.	.35 @	.50
Darvan (dispersing agent)	lb.	.25 @	.47
Santomerse (dispensing, wetting, penetrating and stabilizing agent)	lb.	.11 @	—
Sunproof	lb.	.20 @	.25
Sponge Paste	lb.	— @	.18
Tackol (tackifier)	lb.	.115 @	—
Tonox	lb.	.52 @	.61

SOFTENERS

Acids			
Acetic, 28%, bbls.	100 lb.	2.53 @	2.78
Nitric, 36 degrees	cwt.	5.00 @	6.00
Sulfuric, 66 degrees	ton	15.50 @	16.50
Acids, Fatty			
Laurex	lb.	.10½ @	.13
SL #10	lb.	.12 @	.14
Stearex Beads	lb.	.08 @	.09
Stearic, double pressed	lb.	.12½ @	.13½
Stearite	lb.	.10½ @	.11¾
Alkalies			
Caustic Soda, 76%	cwt.	2.70 @	3.55
Soda Ash, 58%, C.L.	cwt.	— @	2.35
Oils			
Cycline Oil	gal.	.14 @	.20
Degras, bbls.	lb.	.07¾ @	.08
Fluxrite	lb.	.05½ @	.06½
Palm Niger	lb.	.05½ @	.06½
Para-Flux	gal.	.17 @	.18
Para Lube	lb.	— @	.05
Petrolatum, light	lb.	.03½ @	.03½
Pigmentaroil, tank cars	gal.	.16 @	—
in drums	gal.	.22½ @	.23½
Pine, steam distilled	gal.	.64 @	.69
Rosin Oil, cmpd	gal.	.40 @	—
Rubberol, f.o.b. Chicago	lb.	.13½ @	.14
Rubtack	lb.	.08 @	.10
Seedine, c.l.	lb.	.07¼ @	—
Tackol	lb.	.08½ @	.18
Witco Palm Oil	lb.	.07 @	—
Witco Softener No. 20	gal.	.20 @	—
Woburn No. 8, c.l.	lb.	.06 @	—
Wobonite, c.l.	lb.	.05 @	—
Resins and Pitches			
Pitch, Burgundy	lb.	.05½ @	.06½
coal tar	ton	19.00 @	22.00
hardwood	ton	16.00 @	22.50
pine, 200 lb. gr. wt.	bbl.	6.00 @	6.50
Pigmentar, tank cars	gal.	.16 @	—
in drums	gal.	.22½ @	.23½
R. S. L. Resin	lb.	— @	—
Retort Pine Tar, drums	ton	20.00 @	26.00
Solvents			
Acetone, pure	lb.	— @	.06¼
Alcohol, denatured, methanol, No. 1 bbls.	gal.	.33 @	.39
Benzene, 90%	gal.	.18 @	.23
Beta-Trichlorethane	gal.	— @	.20
Bondogen	lb.	.98 @	1.50
Carbon, bisulfide	lb.	.05¼ @	.08
Carbon tetrachloride	lb.	.05½ @	.08
Dichlorethylene	lb.	— @	.25
Dipentene, cml., drums	gal.	.41 @	.50
Ethylene dichloride	lb.	.05½ @	.06½
Plastogen	lb.	.07¾ @	.12½
Reogen (drums)	lb.	.11½ @	.20
Rub-Sol (f.o.b. Okla.)	gal.	.09 @	—
Trichlorethylene	lb.	— @	.09½
Turpentine, spirits	gal.	.43 @	.47
dest. dist., drums	gal.	.33 @	.41
Waxes			
Beeswax, white	lb.	.39 @	.45
Carnauba, yellow	lb.	.46 @	.47½
Ceresin, white, dom.	lb.	.08 @	.11
Montan, crude	lb.	.10¾ @	.11¾
Paraffin (c.l.—f.o.b. N. Y.)			
Yellow crude scale	lb.	.02¾ @	—
White crude scale 124/126	lb.	.02¾ @	.03
Refined, 122/127	lb.	.04½ @	—

ANTI-OXIDANTS

Agerite Alba	lb.	1.50 @	1.95
Exel	lb.	1.00 @	1.40
Gel	lb.	.57 @	.73
Hipar	lb.	.65 @	.92
Powder	lb.	.52 @	.64
Resin	lb.	.52 @	.64
Resin D	lb.	.52 @	.64
White	lb.	1.25 @	1.60
Albasan	lb.	.70 @	.75
Antox	lb.	.56 @	.58
B-L-E	lb.	.52 @	.61
Flectol B	lb.	.52 @	.65
Flectol H	lb.	.52 @	.65
Flectol White	lb.	.90 @	1.15
Neozone	lb.	.52 @	.63
Oxynone	lb.	.65 @	—
Retardex	lb.	.35 @	.40
Santoflex B	lb.	.52 @	.65
Santovar A	lb.	1.15 @	1.40
S.C.R.	lb.	.33 @	.35
Stabilite	lb.	.52 @	.54
Stanilite Alba	lb.	.70 @	.75
VGB	lb.	.52 @	.61

MOLD LUBRICANTS

Aresklene	lb.	— @	—
Cocoa Soapstock	lb.	.06 @	.08
Dipex	lb.	.06 @	.08
Lubrex	lb.	.?5 @	.30
Mold Paste	lb.	.12 @	.18
Rubberol, f.o.b. Chicago	lb.	.13½ @	.14
Rusco, f.o.b. Nitro	lb.	.12 @	.30
Sericite, f.o.b. N. Y.	ton	65.00 @	—
Soap Tree Bark, cut, sifted	lb.	.06 @	.08

FACTICE OR RUBBER SUBSTITUTES

Amberex	lb.	.17 @	—
Black	lb.	.07 @	.11
White	lb.	.07¼ @	.11
Brown	lb.	.07 @	.09¼
Neophax	lb.	.09¼ @	—

VULCANIZING INGREDIENTS

Dispersed Sulfur No. 2	lb.	.07½ @	.15
Sulfur Chloride, yellow (drs.)	lb.	.04 @	—
Sulfur flour,			
Refined, 100% pure (bags)	cwt.	2.50 @	3.65
Commercial (bags)	cwt.	1.60 @	2.35
Telloy	lb.	1.75 @	—
Vandex	lb.	1.75 @	—

Crude Rubber
Latex and Guayule
Reclaimed Rubber
Tires and Tubes

STATISTICS OF THE INDUSTRY

Rim Production
Automobiles
Gasoline
Cotton Prices

U. S. Imports and Exports of Crude Rubber

YEARS	Gross Imports: Long Tons	Gross Imports: Total Declared Value	Gross Imports: Average Declared Value per pound Cents	Re-exports: Long Tons	Re-exports: Total Declared Value	Re-exports: Average Declared Value per pound Cents	Net Imports: Long Tons
1924	325,899	173,367,272	23.75	10,309	6,057,637	26.23	315,590
1925	393,370	426,167,504	48.36	14,827	19,847,753	59.76	378,543
1926	409,944	501,131,064	54.57	17,671	22,470,583	56.77	392,273
1927	424,733	338,688,492	35.60	27,775	24,735,488	39.76	396,958
1928	432,633	242,727,423	25.05	32,159	18,128,761	25.17	400,474
1929	560,082	239,177,811	19.06	36,485	16,868,718	20.64	523,597
1930	482,083	139,133,048	12.88	30,205	9,310,205	13.76	451,878
1931	497,176	72,922,845	6.55	25,595	4,255,572	7.42	471,581
1932	409,556	31,936,459	3.48	20,930	2,015,612	4.30	388,626
1933	407,817	44,034,064	4.82	20,537	2,601,352	5.65	387,280
1934	449,513	97,929,676	9.73	23,848	5,770,109	10.80	425,665
1935	453,134	115,299,448	11.36	11,389	3,084,331	12.09	441,745
1936	467,064	152,072,496	14.54	12,581	4,488,223	15.93	454,483
1937	574,600	237,307,041	18.44	7,902	3,385,433	19.02	566,698
1938	397,620	125,357,730	14.07	5,652	1,799,124	14.21	391,968
1938:							
May	27,229	8,010,250	13.13	528	167,831	14.20	26,701
June	25,983	7,150,115	12.29	399	116,458	13.03	25,584
July	21,771	5,723,381	11.74	420	127,522	13.54	21,351
Aug.	30,798	8,477,231	12.29	432	133,350	13.79	30,366
Sept.	34,383	10,650,107	13.83	803	242,324	13.48	33,580
Oct.	33,449	10,945,896	14.61	621	196,523	14.14	32,828
Nov.	31,903	10,572,345	14.79	415	146,276	15.73	31,488
Dec.	36,031	12,601,926	15.61	424	141,364	14.87	35,607
1939							
Jan.	35,255	12,313,006	15.59	468	165,663	15.79	34,787
Feb.	29,109	10,269,224	15.75	460	152,113	14.76	28,649
Mar.	43,490	15,058,279	15.46	439	171,279	17.43	43,051
Apr.	30,836	10,400,125	15.06	440	151,644	15.38	30,396
May	42,998	15,041,433	15.62	496	180,091	16.20	42,502

* Revised.

Note: "Gross Imports" do not include latex or guayule. To secure more accurate figures for "Net Imports" latex and guayule figures (shown below) should be added and the re-export figure deducted from the total. Annual figures for 1922, however, include both latex and guayule; guayule only is included in 1923. Annual figures for 1922-36 were revised in February, 1937.

United States Imports of Guayule, Balata, Jelutong, Liquid Latex

(All Quantities in Long Tons)

	Guayule Tons	Guayule Dollars	Balata Tons	Balata Dollars	Jelutong Tons	Jelutong Dollars	Liquid Latex (1) Tons	Liquid Latex (1) Dollars
1924	1,356	536,392	464	568,456	6,165	1,237,100	2,157	864,059
1925	3,781	1,803,448	517	574,750	6,749	1,642,531	3,272	3,537,510
1926	4,305	2,562,096	354	327,213	7,263	3,127,757	3,394	4,686,743
1927	5,018	2,674,957	582	477,246	7,785	2,448,657	1,495	1,170,650
1928	3,077	1,755,685	731	430,855	7,552	2,540,059	4,007	2,121,786
1929	1,275	545,175	728	566,964	8,204	2,458,126	3,729	1,788,391
1930	1,096	347,388	502	422,684	5,907	1,403,244	4,458	1,508,786
1931	....	.....	1,207	411,380	5,777	1,019,010	4,675	888,909
1932	....	.....	707	147,403	4,607	616,596	5,112	601,999
1933	....	.....	1,659	2,261,869	5,990	944,895	11,085	1,833,671
1934	398	75,349	1,054	438,209	4,987	943,752	13,107	3,643,221
1935	459	86,835	615	188,384	5,644	1,063,126	13,553	3,782,222
1936	1,229	286,552	535	199,368	6,163	1,296,364	19,852	6,659,899
1937	2,694	745,873	354	151,344	7,109	2,017,786	23,185	10,213,670
1938	2,485	623,819	509	181,140	9,132	2,944,504	11,878	4,147,318
1938:								
May	229	61,756	29	8,806	900	274,652	879	279,502
June	150	41,518	34	11,496	918	276,126	695	214,420
July	223	49,099	51	16,130	869	267,491	634	209,526
Aug.	250	53,285	41	13,637	526	159,784	876	308,573
Sept.	173	37,954	39	13,896	740	225,161	683	235,242
Oct.	126	27,692	45	20,641	614	163,635	876	347,348
Nov.	59	12,923	66	24,725	307	76,452	1,020	394,082
Dec.	181	39,869	13	6,263	917	237,653	1,263	479,966
1939:								
Jan.	226	49,580	61	20,417	843	203,753	1,602	599,927
Feb.	212	46,576	15	4,426	510	129,726	1,717	657,565
Mar.	229	39,520	14	5,215	641	136,112	2,005	731,302
Apr.	180	24,584	59	18,170	281	72,024	1,018	360,739
May	102	22,347	56	16,359	645	161,745	2,786	1,067,682

(1) Weight given in pounds of dry rubber contained in latex.
Note: Annual figures for 1924-1936 revised on basis of information received on February 8, 1937.

U. S. Consumption of Crude Rubber

(Rubber Manufacturers' Association statistics raised to 100 per cent—All figures in long tons)

	Figures on Monthly Basis: 1932*	1933*	1934*	1935*	1936*	1937*	1938*	1939
Jan.	29,648	22,645	39,190	46,636	48,631	50,879	31,265	46,234
Feb.	31,821	21,392	40,515	42,720	36,841	51,950	25,357	42,365
Mar.	29,505	17,843	47,003	42,153	42,813	54,129	32,389	50,165
Apr.	27,518	25,928	44,853	44,247	52,031	51,859	29,730	44,166
May	30,957	44,074	42,918	41,101	50,612	51,795	30,753	44,377
June	41,475	50,743	40,147	36,156	52,772	51,860	32,540	
July	29,976	49,614	32,553	35,917	48,250	43,703	34,219	
Aug.	23,721	44,428	33,216	38,775	46,777	41,506	40,552	
Sept.	23,847	35,281	30,258	37,086	46,449	43,945	40,183	
Oct.	22,286	31,543	31,253	41,969	49,637	38,754	42,850	
Nov.	23,231	28,831	34,748	42,310	50,433	34,025	49,050	
Dec.	18,015	28,757	36,569	42,474	49,754	29,195	48,143	
Tot.	332,000	401,079	453,223	491,544	575,000	543,600	437,031	

* Revised.
Note: All figures are now based on Department of Commerce survey figures.

Reclaimed Rubber in the United States

(All Quantities in Long Tons)

Year	Production	Consumption Tons	Consumption % to Crude	Stocks*	Year	Production	Consumption Tons	Consumption % to Crude	Stocks*
1929	218,954	226,588	48.4	27,464	1934	110,010	100,597	22.2	23,079
1930	157,967	153,497	40.8	22,000	1935	122,948	113,078	23.0	25,069
1931	133,351	124,126	33.9	19,257	1936	150,571	141,486	24.6	19,000
1932	75,608	77,504	23.4	16,354	1937*	185,033	162,000	29.8	28,800
1933	99,560	81,602	19.9	20,746	1938*	122,403	120,800	27.6	23,000
	Figures on Monthly Basis								
1938:*									
Jan.	8,303	7,463	23.9	28,982	July	7,668	8,777	25.6	18,956
Feb.	6,685	7,679	30.3	27,518	Aug.	11,295	11,387	28.1	18,307
Mar.	7,416	9,109	28.1	25,366	Sept.	12,961	11,969	29.8	18,540
Apr.	6,902	8,043	27.1	23,799	Oct.	14,624	12,522	29.2	19,910
May	7,406	8,613	28.0	22,042	Nov.	15,095	13,440	27.4	21,001
June	8,180	8,779	27.0	20,785	Dec.	15,868	13,019	27.1	23,000
1939:									
Jan.	13,763	13,000	28.1	21,960	July	.....	.....	...	.....
Feb.	13,093	12,626	29.8	21,390	Aug.	.....	.....	...	.....
Mar.	14,528	15,322	30.5	19,955	Sept.	.....	.....	...	.....
Apr.	14,527	13,391	30.3	22,628	Oct.	.....	.....	...	.....
May	14,769	13,517	30.5	22,771	Nov.	.....	.....	...	.....
June	.....	.....	...	.....	Dec.	.....	.....	...	.....

* Stocks on hand at the end of month or year.
* Revised.
Note: Figures for 1938 were revised on June 1, 1939, and are now based on Department of Commerce survey figures.

U. S. Consumption of Gasoline

(Bureau of Mines Statistics)
(In Thousands of Barrels of 42 Gallons)

	1937*	1938	1939		1937*	1938	1939
January	33,668	35,176	37,847	August	49,598	50,459	.....
February	32,034	31,861	34,595	September	47,515	46,058	.....
March	40,524	41,259	42,520	October	45,446	46,272	.....
April	43,461	43,254	43,977	November	42,718	44,991	.....
May	45,407	44,911	.....	December	39,465	41,649	.....
June	48,447	48,293	.....				
July	51,069	47,474	.....	Total	519,352	521,657	.....

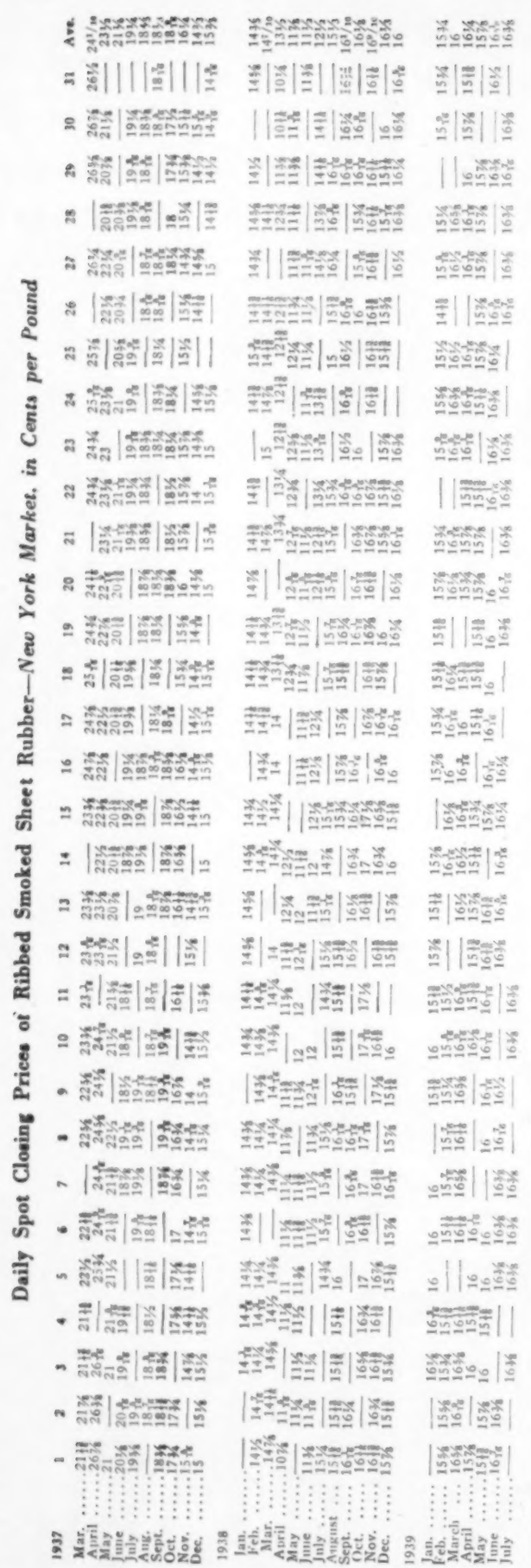
* Revised.

Rims Inspected and Passed in U. S.

(Tire and Rim Association Reports)

	Total		Total		Total
1927	19,700,003	1931	11,253,800	1935	18,664,356
1928	24,247,282	1932	6,261,336	1936	20,790,192
1929	24,141,502	1933	8,713,962	1937	22,257,964
1930	17,364,096	1934	12,255,118	1938	10,612,138

1939		1939		1939	
January ...	1,714,137	May	1,243,519	September .	.....
February ..	1,442,535	June	.....	October ...	.....
March	1,730,211	July	.....	November .	.....
April	1,348,335	August	.....	December .	.....

Daily Spot Closing Prices of Ribbed Smoked Sheet Rubber—*New York Market, in Cents per Pound*

Average Spot Closing Prices—Ribbed Smoked Sheets

(New York Markets)

Average Price per Pound for Years 1911-1931

Year	Cents	Year	Cents	Year	Cents	Year	Cents	Year	Cents
1912	121.60	1916	72.50	1920	36.30	1924	26.20	1928	22.48
1913	82.04	1917	72.23	1921	16.36	1925	72.46	1929	20.55
1914	65.33	1918	60.15	1922	17.50	1926	48.50	1930	11.98
1915	65.85	1919	48.70	1923	29.45	1927	37.72	1931	6.17

Average Monthly Price per Pound Since 1932

	1932 Cents	1933 Cents	1934 Cents	1935 Cents	1936 Cents	1937 Cents	1938 Cents	1939 Cents
Jan.	4.38	3.08	9.32	13.10	14.35	21.37	14.63	15.75
Feb.	4.03	2.95	10.45	12.92	15.48	21.33	14.71	15.93
Mar.	3.35	3.01	11.01	11.51	15.89	24.09	13.55	16.26
Apr.	3.02	3.56	12.10	11.55	15.98	23.44	11.84	15.87
May	3.09	4.95	13.26	12.05	15.62	21.14	11.57	16.07
June	2.66	6.15	13.51	12.57	15.85	19.29	12.57	16.37
July	2.89	8.01	14.60	12.10	16.49	18.86	15.37	
Aug.	3.63	7.31	15.47	11.98	16.25	18.37	16.08	
Sept.	3.84	7.30	15.36	11.55	16.46	18.55	16.15	
Oct.	3.65	7.64	13.96	12.62	16.55	16.28	16.89	
Nov.	3.44	8.66	13.04	13.15	17.97	14.60	16.24	
Dec.	3.24	8.87	12.98	13.28	20.01	15.41	16.05	
Average for Year	3.49	5.96	12.92	12.37	16.41	19.39	14.64	

London Closing Prices of Ribbed Smoked Sheets

(In Pence Per Pound)

Day	1939 Apr.	1939 May	1939 June	1939 July	Day	1939 Apr.	1939 May	1939 June	1939 July
1	7 7/16	7 7/8	8 1/16	——	17	7 7/8	8	——	
2	——	7 7/8	8 1/4	——	18	7 7/8	8	——	
3	8	7	——	8 3/16	19	7 7/8	8	8 3/16	
4	7 7/8	7	——	8 3/16	20	7	——	8 1/16	
5	7	7	8 1/4	8 3/16	21	7 7/8	——	8 1/16	
6	7	7	8 1/16	8 3/16	22	7	8	8 1/16	
7	——	——	8 1/4	8 3/16	23	——	8 1/16	8 1/16	
8	——	7	8 1/4	——	24	7 7/8	8 1/8	——	
9	——	7	8 1/4	——	25	7 7/8	8 1/4	——	
10	——	8	——	8 3/16	26	7	8 1/4	8 1/4	
11	7 7/8	7	——	8 1/16	27	7 7/8	——	8 1/4	
12	7	7 7/8	8 1/16		28	7	——	8 1/4	
13	7	——	8 3/16		29	7	——	8 3/16	
14	7	——	8 3/16		30	——	——	8 3/16	
15	7 7/8	7 7/8	8 3/16		31	——	8 1/16	——	
16	——	8	8 1/16						

Average Monthly Price Per Pound

Month	1936 Pence	1937 Pence	1938 Pence	1939 Pence	Month	1936 Pence	1937 Pence	1938 Pence	1939 Pence
Jan.	6.758	10.378	7.077	7.926	Aug.	7.581	8.830	7.841	
Feb.	7.255	10.503	7.029	7.942	Sept.	7.577	8.935	7.918	
Mar.	7.450	11.766	6.590	8.120	Oct.	7.898	7.855	8.355	
Apr.	7.502	11.471	5.793	7.910	Nov.	8.572	7.080	8.111	
May	7.335	10.250	5.632	8.002	Dec.	9.580	7.332	8.005	
June	7.352	9.548	6.147	8.216	Average for Year	7.713	9.424	7.164	
July	7.696	9.136	7.464						

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market)

Recent Daily Price Per Pound

Date	1939 May	1939 June	1939 July	Date	1939 May	1939 June	1939 July	Date	1939 May	1939 June	1939 July
1	9.24	9.70	9.75	11	9.44	——	9.98	22	9.73	9.90	
2	9.17	9.78	——	12	9.44	9.89		23	9.74	9.97	
3	9.24	9.78	9.87	13	9.51	9.92		24	9.85	9.91	
4	9.26	——	——	14	——	9.97		25	9.83	——	
5	9.31	9.92	9.82	15	9.43	9.87		26	9.81	9.91	
6	9.36	9.82	9.83	16	9.55	9.86		27	9.77	9.97	
7	——	9.91	9.96	17	9.68	9.87		28	——	9.83	
8	9.40	10.00	9.87	18	9.79	——		29	9.74	9.83	
9	9.58	9.99	——	19	9.78	9.91		30	——	9.71	
10	9.46	9.98	10.02	20	9.76	9.86		31	9.81	——	
				21	——	9.87					

Average Monthly Price Per Pound

	1936 Cents	1937 Cents	1938 Cents	1939 Cents		1936 Cents	1937 Cents	1938 Cents	1939 Cents
Jan.	11.91	13.06	8.57	8.94	Aug.	12.28	10.41	8.41	
Feb.	11.53	13.15	8.91	8.97	Sept.	12.31	9.02	8.17	
Mar.	11.43	14.46	8.92	9.00	Oct.	12.30	8.42	8.61	
Apr.	11.71	14.23	8.76	8.87	Nov.	12.23	7.96	9.08	
May	11.68	13.34	8.50	9.56	Dec.	12.83	8.26	8.72	
June	12.02	12.70	8.38	9.88	Average for Year	12.11	11.44	8.66	
July	13.11	12.26	8.85						

Stocks of Crude Rubber

(All figures are in long tons)

ON HAND OR AFLOAT TO THE U. S.

End of:	ON HAND 1937	ON HAND 1938*	ON HAND 1939	AFLOAT 1937	AFLOAT 1938	AFLOAT 1939	ON HAND AND AFLOAT 1937	ON HAND AND AFLOAT 1938*	ON HAND AND AFLOAT 1939
Jan.	204,436	276,497	237,826	55,096	57,356	48,210	259,532	333,853	286,036
Feb.	195,692	292,067	231,475	53,538	47,459	55,814	249,230	339,526	287,289
Mar.	192,980	301,762	205,936	56,994	41,882	55,981	249,974	343,644	261,917
Apr.	176,289	303,901	190,896	72,530	39,071	57,918	248,819	342,972	248,814
May	175,273	300,907	193,602	58,542	32,859	54,046	233,815	333,766	247,648
June	172,056	294,796		57,215	32,079		229,271	326,875	
July	167,094	282,785		75,779	40,400		242,873	323,185	
Aug.	174,195	273,841		80,439	47,772		254,634	321,613	
Sept.	186,193	268,094		83,288	48,927		269,481	317,021	
Oct.	200,025	259,074		80,653	50,162		280,678	310,136	
Nov.	222,707	242,592		81,302	51,114		304,009	293,706	
Dec.	262,204	231,500		63,099	45,105		325,303	276,605	

* Revised.

STOCKS IN GREAT BRITAIN

(No. of Tons in Wharves and Warehouses, not including Latex)

At end of	London 1937	London 1938	London 1939	Liverpool 1937	Liverpool 1938	Liverpool 1939
January	29,005	40,203	51,420	41,895	21,711	28,789
February	26,508	46,596	48,312	37,078	24,737	26,784
March	21,292	50,233	46,768	30,622	26,220	24,996
April	21,128	54,296	44,760	27,443	28,277	23,742
May	21,351	57,194	43,454	25,081	29,862	22,211
June	21,964	60,307		21,258	31,837	
July	22,589	62,236		19,424	32,825	
August	25,211	65,113		19,817	34,315	
September	28,462	63,321		21,190	34,645	
October	30,465	59,609		21,327	33,483	
November	33,304	57,794		21,399	32,116	
December	35,633	55,668		21,978	31,012	

(Figures from the Rubber Trade Association of London)

STOCKS IN OTHER CENTRES

(Figures from Statistical Bulletin of the Int'l Rubber Regulation Committee)

	Penang and Singapore [1]	Malaya [2]	Ceylon [2]	Holland	Para and Manaos
At end of 1938					
May	40,598	45,426	4,876	169	816
June	44,729	49,290	4,488	190	904*
July	45,529	52,081	5,014	711	944
August	41,002	49,922	4,659	672	1,032
September	35,386	53,815	5,339	662	1,599
October	34,901	54,720	4,916	669	1,796*
November	31,255	54,283	4,409	349	2,267
December	27,084	57,800	6,120	268	1,864
At end of 1939					
January	30,975	59,155	4,827	198	1,557
February	28,559	59,399	4,318	183	1,826
March	23,255	58,005	3,389	137	1,457
April	22,434	55,238	3,648	131	2,209

[1] Dealers' and Port Stocks. [2] Inside Regulated Areas. [3] Dealers' Stocks Only.
* Revised.

RUBBER STOCKS AFLOAT

End of:	Afloat for United States	Afloat for Europe	All Other * Afloat	Total * Afloat
1938				
April	39,071	42,960	31,969	114,000
May	32,859	40,600	20,541	94,000
June	32,079	42,580	17,341	92,000
July	40,400	39,150	25,450	105,000
August	47,772	34,500	18,728	101,000
September	48,927	29,200	17,873	96,000
October	51,062	26,100	21,838	99,000
November	51,114	26,700	14,186	92,000
December	45,105	26,800	8,095	80,000
1939				
January	48,210	27,900	28,890	105,000
February	55,814	28,300	21,886	106,000
March	55,981	25,200	20,819	102,000
April	57,918	24,000	17,082	99,000
May	54,046	25,000	15,954	95,000

* *Total Afloat* is an arbitrary estimate based on 1½ months' shipments as adopted by the Department of Commerce. *All Other Afloat* is determined by subtracting the amount of stocks in transit to the United States and Europe from the estimated total.
P—Preliminary estimate.

TOTAL PRINCIPAL WORLD STOCKS

(Figures from the Survey of Current Business)

At End of:	1934	1935	1936	1937*	1938*	1939
January	661,948	698,153	600,479	454,249	549,762	497,665
February	663,308	686,195	599,355	445,265	565,833	479,578
March	666,382	678,809	583,318	447,856	586,666	460,723
April	658,796	677,006	567,172	428,249	586,291	438,252
May	689,239	677,569	541,871	413,134	568,158	428,979
June	672,804	671,525	520,255	434,250	573,136	.....
July	676,200	679,061	519,074	445,782	580,654	.....
August	674,702	680,644	500,520	457,462	565,394	.....
September	694,361	661,509	493,585	470,768	551,447	.....
October	680,616	655,000	486,159	479,398	540,976	.....
November	684,408	617,300	466,491	493,266	512,196	.....
December	705,975	613,987	466,576	545,533	482,852	.....
Monthly Avge.	677,395	666,397	528,738	460,022	555,280	.....

* Revised.

U. S. Tire and Tube Statistics[1]

(All Figures Represent Thousands)

AUTOMOBILE CASINGS

Production Figures on Quarterly Basis

Quarter	1932	1933	1934	1935	1936*	1937*	1938*	1939
Jan.-Mar.	11,004	6,635	13,437	13,355	11,376	15,565	7,532	14,062
Apr.-June	12,980	14,412	13,565	12,597	14,892	15,834	8,358	
July-Sept.	9,245	14,707	9,822	11,312	14,914	12,207	11,240	
Oct.-Dec.	6,856	9,550	10,406	12,099	14,858	9,704	13,052	
Total	40,085	45,304	47,230	49,363	56,040	53,310	40,182	

Shipment Figures on Quarterly Basis

Quarter	1932	1933	1934	1935	1936*	1937*	1938*	1939
Jan.-Mar.	8,760	6,981	10,730	11,154	10,554	14,143	7,534	12,484
Apr.-June	18,021	15,139	14,998	13,473	15,940	15,741	10,363	
July-Sept.	8,141	13,707	11,648	13,489	14,037	13,106	11,748	
Oct.-Dec.	5,329	8,265	9,310	12,066	12,855	10,495	12,685	
Total	40,251	44,092	46,686	50,182	53,386	53,485	42,330	

Inventory Figures [2]

Quarter	1932	1933	1934	1935	1936*	1937*	1938*	1939
Jan.-Mar.	9,878	7,290	11,651	11,675	8,762	12,004	10,521	10,109
Apr.-June	4,999	6,615	10,219	10,755	7,556	12,081	8,470	
July-Sept.	6,096	7,595	8,419	8,288	8,690	11,200	8,022	
Oct.-Dec.	7,644	8,888	9,455	8,196	10,717	10,383	8,451	

Figures for Recent Months

	PRODUCTION 1937	PRODUCTION 1938	PRODUCTION 1939	SHIPMENTS 1937	SHIPMENTS 1938	SHIPMENTS 1939	INVENTORY [2] 1937	INVENTORY [2] 1938	INVENTORY [2] 1939
Apr.	5,525	2,660	4,211	5,362	3,143	4,356	12,178	10,141	9,998
May	5,161	2,663	4,418	5,183	3,291	4,753	12,142	9,521	9,919
June	5,149	3,036		5,197	3,929		12,081	8,470	

AUTOMOBILE INNER TUBES

Production Figures on Quarterly Basis

Quarter	1932	1933	1934	1935	1936*	1937*	1938*	1939
Jan.-Mar.	10,721	6,230	12,823	12,553	11,891	15,831	7,314	12,248
Apr.-June	11,913	13,001	13,191	11,631	14,624	15,413	7,380	
July-Sept.	8,286	14,356	10,321	11,270	15,320	12,038	10,794	
Oct.-Dec.	5,970	9,000	9,891	12,425	15,201	9,092	12,360	
Total	36,890	42,587	46,226	47,879	57,036	52,374	37,848	

Shipment Figures on Quarterly Basis

Quarter	1932	1933	1934	1935	1936*	1937*	1938*	1939
Jan.-Mar.	8,918	6,539	10,640	11,252	11,367	14,606	7,387	11,286
Apr.-June	16,271	13,292	14,553	11,928	15,113	15,495	9,564	
July-Sept.	7,761	13,370	11,545	13,251	15,069	12,901	11,243	
Oct.-Dec.	4,961	8,189	8,306	11,636	12,874	9,765	12,099	
Total	37,911	41,390	45,044	48,067	54,423	52,767	40,239	

Inventory Figures [2]

Quarter	1932	1933	1934	1935	1936*	1937*	1938*	1939
Jan.-Mar.	9,448	6,369	10,244	10,406	8,660	11,993	10,547	8,901
Apr.-June	5,174	6,097	8,795	10,050	8,075	11,833	8,337	
July-Sept.	5,753	7,008	7,639	7,565	8,595	11,326	7,859	
Oct.-Dec.	6,749	7,815	9,180	8,231	10,945	10,312	8,166	

Figures for Recent Months

	PRODUCTION 1937	PRODUCTION 1938	PRODUCTION 1939	SHIPMENTS 1937	SHIPMENTS 1938	SHIPMENTS 1939	INVENTORY [2] 1937	INVENTORY [2] 1938	INVENTORY [2] 1939
Apr.	5,669	2,258	3,841	5,365	2,860	3,927	12,309	9,917	8,837
May	4,993	2,325	3,848	5,066	2,974	4,154	12,197	9,265	8,840
June	4,751	2,797		5,064	3,730		11,833	8,337	

[1] Based on reports received from the Rubber Manufacturers Association.
[2] Held by manufacturers at end of period indicated.
* Revised.

Automobile Production

	United States Total	United States Passenger Cars	United States Trucks	Canada Total	Canada Passenger Cars	Canada Trucks	Grand Total
1928	4,357,384	3,826,613	530,771	242,382	196,737	45,645	4,599,944
1929	5,358,420	4,587,400	771,020	263,295	207,498	55,797	5,621,715
1930	3,355,986	2,814,452	540,534	154,192	125,442	28,750	3,510,178
1931	2,389,730	1,973,090	416,640	82,621	63,477	19,144	2,472,351
1932	1,370,678	1,135,493	235,187	60,816	50,718	10,098	1,431,494
1933*	1,920,057	1,573,512	346,545	65,924	53,855	12,069	1,992,126
1934*	2,753,111	2,177,919	575,192	116,852	92,647	24,205	2,869,963
1935*	3,946,934	3,252,244	694,690	172,877	135,562	37,315	4,119,811
1936*	4,454,115	3,669,528	784,587	162,159	128,369	33,790	4,616,274
1937*	4,808,974	3,915,889	893,085	207,463	153,046	54,417	5,016,437
1938	2,489,635	2,000,985	488,650	166,142	125,081	41,061	2,655,777
1938*							
Oct.	209,512	187,494	22,018	5,774	5,412	362	215,286
Nov.	372,413	320,344	52,069	17,992	15,423	2,569	390,405
Dec.	388,346	326,006	62,340	18,670	15,518	3,152	407,016
1939							
Jan.	339,152	280,033*	59,119*	14,794	11,404	3,390	353,946
Feb.	297,841	239,980*	57,861*	14,300	10,914	3,386	312,141
Mar.	371,940	299,703	72,237	17,549	12,689	4,860	389,489
Apr.	337,372	273,409	63,963	16,891	12,791	4,100	354,263
May	297,508	237,870	59,638	15,706	11,585	4,121	313,214
June	.....	.....	.....	.....	.....	.....	.....

* Revised.
Note: U. S. figures represent factory sales; Canadian figures represent production.

Exports of Crude Rubber from Principal Producing Countries

(Long Tons)

	BRITISH MALAYA [1]							NETHERLAND INDIES [4]						
	Gross Exports	Imports	Net Exports	Ceylon [2]	India & Burma [3]	Sarawak [3]	British North Borneo [3]	Siam [3]	Java & Madura	Sumatra E. Coast	Other N. I.	Indo-China [3]	Amazon Valley	All Other [5]	World Total [6]
1923	252,016	70,432	181,584	39,971	6,416	5,705	4,237	1,718	32,930	46,344	57,822	3,067	16,765	7,856	406,413
1924	259,706	108,524	151,182	39,997	7,697	6,699	4,621	2,962	42,446	54,497	80,347	6,688	23,165	9,065	429,366
1925	316,825	158,022	158,803	49,566	10,082	5,424	5,377	5,377	46,757	65,499	120,626	7,881	25,298	13,797	514,487
1926	391,328	151,243	240,085	58,962	9,874	9,155	6,079	4,027	52,186	71,413	121,231	8,203	24,298	16,017	621,530
1927	371,322	182,845	188,477	55,356	11,321	10,923	6,582	5,472	55,297	77,815	142,171	8,645	28,782	15,633	606,474
1928	409,430	149,787	259,643	57,267	10,790	10,087	6,698	4,813	58,848	82,511	121,770	9,548	21,129	10,690	653,796
1929	574,836	163,092	411,744	81,584	11,663	11,077	7,381	5,018	65,990	87,789	134,037	9,696	21,148	6,767	853,894
1930	547,043	133,876	413,167	76,970	10,782	10,309	6,781	4,251	69,755	79,396	115,254	7,665	14,260	5,651	814,241
1931	519,740	125,506	394,234	61,769	8,470	10,451	6,247	4,218	75,952	87,747	116,009	11,696	12,121	3,293	792,200
1932	478,252	92,539	385,713	48,973	3,888	6,960	4,664	3,451	61,312	79,837	85,871	13,883	6,450	1,816	702,815
1933	573,412	167,377	406,035	63,351	4,527	10,874	7,555	7,765	73,851	91,861	149,659	18,394	9,883	2,737	846,312
1934	677,361	211,803	465,558	79,746	10,492	17,233	11,103	17,545	87,400	112,058	175,470	20,170	8,903	2,985	1,008,663
1935	590,319	174,652	415,667	54,316	13,968	19,465	8,885	28,327	57,488	78,325	139,297	28,816	11,275	8,745	864,574
1936	520,286	167,799	352,487	49,692	14,724	21,243	8,177	33,702	61,307	84,577	152,205	40,782	14,193	11,466	845,431
1937	681,638	213,446	468,192	70,353	17,015	25,922	13,213	5,551	84,085	139,632	207,863	43,399	15,576	13,063	1,133,864
1938	526,911	156,101	370,810	49,528	15,178	17,792	9,512	41,080	57,526	94,501	145,909	58,518	14,618	12,920	887,892
1938:															
Feb.	48,899	11,874	37,025	5,216	1,409	8	918	3,266	6,391	8,777	12,154	3,070	1,542	1,032	80,808
Mar.	49,197	15,813	33,384	3,834	1,235	1,564	853	2,837	5,673	10,156	15,447	3,213	1,831	1,322	81,349
Apr.	53,864	9,158	44,706	1,951	1,327	1,728	1,158	1,583	5,967	10,081	12,434	3,647	1,004	774	86,360
May	38,245	10,325	27,920	2,833	1,470	1,648	815	2,507	4,575	7,515	9,944	3,118	1,053	904	64,302
June	42,258	14,394	27,864	3,693	1,318	2,441	643	3,904	4,519	7,788	12,120	4,776	718	818	70,602
July	43,689	18,713	24,976	3,861	1,083	2,057	937	4,710	6,808	8,271	19,955	5,139	625	1,063	79,485
Aug.	47,246	13,735	33,511	4,401	953	965	728	4,793	4,757	7,339	11,006	3,840	1,050	1,074	74,417
Sept.	40,992	10,586	30,406	3,990	1,036	756	284	3,893	4,026	7,052	9,092	8,139	758	1,292	70,724
Oct.	42,294	16,599	25,695	4,893	1,111	1,612	1,075	4,438	4,486	8,229	17,166	3,638	1,796	1,092	75,231
Nov.	39,340	10,219	29,121	6,422	1,271	929	567	3,223	3,975	5,678	9,568	4,035	1,159	990	66,938
Dec.	32,901	7,607	25,294	3,212	1,586	599	227	3,029	1,873	4,332	4,315	9,815	2,205	1,021	57,508
1939:															
Jan.	43,332	19,049	24,283	7,237	1,879	2,342	1,604	2,918	6,787	11,261	20,630	4,739	1,708	1,200*	86,588
Feb.	43,084	13,889	29,195	5,575	1,565	1,484	664	5,606	4,833	8,410	11,658	5,659	1,056	1,200*	76,905
Mar.	43,259	14,035	29,224	3,642	1,406	1,177	344	5,401	5,361	8,084	14,428	4,636	1,331	1,200*	76,234
Apr.	43,668	13,996	29,672	2,246	1,153	2,446	1,687	2,660	5,321	9,250	13,691	2,581	1,200*	1,200*	73,107
May	42,214	13,432	28,782	2,805	1,678	1,649	558	2,782	4,105	8,159	12,009	4,552	1,200*	1,200*	69,479

All figures from January, 1934, onward are net exports shown on a "dry rubber" basis as calculated by the International Rubber Regulation Committee. (1) Prior to January, 1934, Malayan net exports cannot be taken as production, since imported rubber is largely wet native rubber, which is reduced about one-third in weight by remilling; rubber exported as latex also is not included in the early years, which on a dry rubber basis was as follows: 1924—1,117 tons; 1925—3,618; 1926—3,263; 1927—2,439; 1928—2,247; 1929—3,574; 1930—2,750; 1931—1,940; 1932—5,193; 1933—10,470, and 1934—14,172 tons. (2) Ceylon Chamber of Commerce statistics until 1926; rubber exported as latex is not included—such shipments on a dry rubber basis were: 1923—18 tons; 1924—90; 1925—6; 1926—20; 1927—½; 1928—1; 1929—2; 1930—11; 1931—2; 1932—2; 1933—1, and 1934—6 tons. (3) Official statistics. (4) Exports from "Other N. I." are chiefly wet native rubber, which is reduced about one-third in weight by remilling; rubber exported as latex is not included in earlier years, which is as follows on a dry rubber basis: 1923—2,342 tons; 1924—1,008; 1925—2,239; 1926—44; 1927—84; 1928—1,395; 1929—437; 1930—2,744; 1931—3,874; 1932—3,488; 1933—5,260, and 1934—5,330 tons. (5) Calculated from official import statistics of principal consuming countries; also includes United States imports of guayule. (6) This total includes the third column for British Malaya and all other figures shown for other territories. (*) Figure is provisional.

NOTE: ANNUAL FIGURES ARE MORE ACCURATE; THEY ARE REVISED AT THE END OF THE FOLLOWING YEAR.

Net Imports of Crude Rubber into Principal Manufacturing Countries

(Long Tons)

	United States [1]	United Kingdom	France (h)	Germany	Canada (ac)	Japan (da)	Italy	Russia (ce)	Australia (cd)	Belgium (d)	Netherlands	Scandinavia (abcdf)	Spain (g)	Czechoslovakia (abcd)	World Total
1919	238,407	42,671	17,685	5,581	6,395	9,753	9,894	75	1,002	3,995	2,771	3,149	2,418	9	343,808
1920	249,530	56,844	13,885	11,890	11,746	5,297	6,123	62	1,815	3,840	5,510	2,292	2,008	567	371,409
1921	179,736	42,087	15,135	21,920	8,124	21,713	3,906	163	1,014	1,705	1,022	1,279	2,245	569	300,620
1922	296,594	11,724	24,352	27,546	9,207	15,934	6,430	2,493	2,643	172	—3,807	1,778	589	567	396,222
1923	301,527	12,700	27,392	18,519	13,277	15,372	8,489	2,986	1,649	2,184	792	2,528	630	1,128	409,173
1924	319,103	—11,550	30,446	22,727	14,299	19,571	8,764	2,346	3,124	2,688	—807	3,178	944	1,370	416,203
1925	385,596	4,061	32,956	33,937	19,683	11,117	11,412	7,088	4,757	2,930	875	3,149	1,155	1,558	520,274
1926	399,981	84,865	34,240	22,775	20,229	18,125	9,809	6,529	9,021	2,498	2,670	4,046	1,299	1,870	617,957
1927	403,472	60,249	34,271	38,892	26,405	20,521	11,381	12,018	9,490	6,482	636	4,224	2,055	2,672	632,768
1928	407,572	4,846	36,498	37,855	30,447	25,621	12,433	15,134	8,430	7,958	2,243	4,418	3,178	3,138	599,771
1929	528,608	122,675	55,093	49,273	35,453	34,284	17,169	11,774	15,886	9,445	3,022	6,440	864	4,650	894,638
1930	458,036	120,069	68,503	45,488	28,793	33,039	18,639	16,387	5,354	10,635	2,924	7,710	2,400	4,468	822,445
1931	475,993	86,170	46,466	39,688	25,261	43,483	10,149	30,671	7,649	11,009	2,220	6,360	2,605	7,717	794,641
1932	393,844	44,086	42,506	45,121	20,917	56,027	14,469	30,637	12,576	9,519	2,851	7,262	4,359	9,444	693,618
1933	398,365	73,335	61,953	54,120	19,332	66,831	19,341	29,830	13,534	11,166	1,243	7,831	5,520	10,402	772,803
1934	439,172	158,482	49,560	59,330	28,439	69,905	21,398	47,271	9,642	9,115	3,758	12,418	6,900	10,999	926,389
1935	455,758	128,829	51,450	62,899	26,870	57,567	21,880	37,572	9,978	7,593	4,068	11,878	8,140	11,245	895,727
1936	475,359	—2,591	57,032	71,794	27,871	61,223	16,534	30,967	14,109	9,648	2,888	11,236	6,668	8,772	791,510
1937	592,394	92,707	59,871	98,170	36,088	62,311	24,733	30,462	19,164	14,970	4,343	4,680	2,400	13,063	1,055,356
1938	406,343	133,079	59,660	90,200	25,696	45,836	28,170	25,650	11,944	11,309	5,092	16,034	2,400	9,936	871,349
1938:															
Feb.	40,977	16,505	5,456	6,959	615	3,172	2,000	2,341	578	974	534	1,114	200*	1,771	83,196
Mar.	42,075	15,911	4,845	10,768	2,123	6,220	1,365	2,162	1,043	961	342	1,088	200*	1,324	90,427
Apr.	31,870	14,653	5,757	6,497	999	5,454	2,397	4,281	640	904	449	971	200*	920	75,992
May	27,809	14,675	5,169	9,595	2,545	3,327	2,422	4,163	1,041	1,137	419	1,283	200*	957	74,742
June	26,429	14,053	4,542	7,478	3,243	2,145	2,399	505	805	853	663	1,149	200*	988	65,452
July	22,209	12,678	5,433	6,927	2,685	3,099	3,641	541	1,215	1,106	528	1,151	200*	635	62,048
Aug.	31,494	12,891	3,662	7,190	1,832	2,033	2,078	739	1,182	1,238	259	965	200*	595	66,358
Sept.	34,436	8,100	5,094	7,390	1,405	3,584	1,799	1,725	1,779	519	385	1,830	200*	608	68,854
Oct.	33,830	3,085	3,791	6,326	3,139	3,204	3,921	2,000*	1,780	848	420	3,022	200*	9	65,575
Nov.	32,567	936	5,322	7,275	3,123	4,665	1,984	4,000*	660	636	530	1,209	200*	379	63,486
Dec.	37,051	4,134	5,820	7,481	2,198	4,000	2,355	2,500*	647	876	263	1,013	200*	648	69,186
1939:															
Jan.	36,614	814	4,684	7,227	2,867	2,553	2,133	4,000*	910	898	454	1,037	200*	1,131	65,522
Feb.	30,578	4,940	5,315	7,569	1,451	3,263	2,025	2,000*	1,741	1,068	184	858	200*	524	61,716
Mar.	45,286	8,144	4,503	8,036	2,458	4,019	1,525	2,000*	1,316	1,242	368	1,133	200*	883	81,113
Apr.	31,590	4,886	5,639	8,719	1,466	3,579	1,926	2,000*	1,108	853	333	1,062	200*	792	64,153
May	45,390	7,526	4,646	8,413											

a—Including gutta percha. b—Including balata. c—Re-exports not deducted in monthly statistics. d—Including some scrap and reclaimed rubber. e—Official statistics of rubber imports by Soviet Russia. f—Including Norway, Sweden, Denmark and Finland. g—United Kingdom and French exports to Spain except in years prior to 1925. h—French imports have been reduced in order to eliminate imports of gutta percha and to reduce to basis of net weight. [1]—United States imports of guayule are included in this compilation. *—Figure is provisional; final figure will be shown when available.

NOTE: ANNUAL FIGURES ARE MORE ACCURATE: THEY ARE REVISED AT THE END OF THE FOLLOWING YEAR.